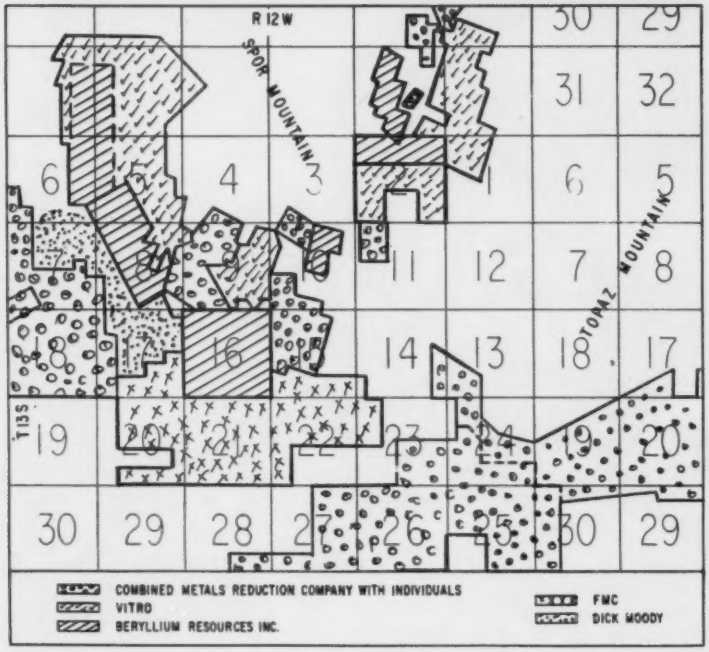
MINING WORLD

September 1961

FIFTY CENTS



BERYLLIUM in the news . . .

- Topaz-Spor Mountain ore reserves sought by many mining companies
- Badger Flats' bertrandite ore milled by MINCON
- Bernic Lake pegmatite found to hold Canadian reserve
- Belgians use $1,000,000 worth of metal in new atomic reactor

▶ 21

ESCALANTE STUDY proves small mines can use computers

1. To plot mining-grade graph as guide to stope planning
2. To calculate ore reserves by two methods
3. To determine best location for shaft and levels

▶ 31

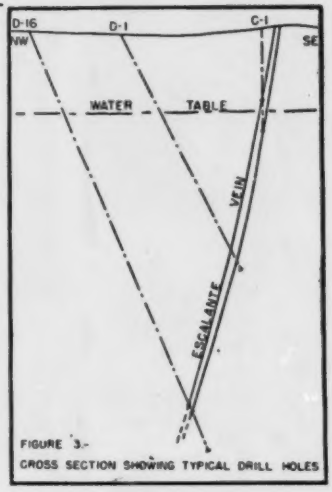


FIGURE 3.-
CROSS SECTION SHOWING TYPICAL DRILL HOLES

4½-yard P&H Electrics working at Craigmont Mines Limited's new mine near Merritt, B.C.

IF PURCHASES ARE ENDORSEMENTS...

P&H is the no. 1 choice of the mining industries

In recent years 68% of all American made 4.5 to 9 yard electric mining shovels bought for use throughout the world have been P&H

P&H has earned such widespread acceptance in the mining industries because of lower per-ton loading cost. This profit premium to owners of P&H Electrics results from these two basic advantages:

1. **Higher rate of production** made possible by exclusive, patented P&H design principles of MAGNETORQUE® eddy-current hoist drive and Static Electronic Control. Both of these far-ahead design principles pioneered by Harnischfeger are the direct result of Harnischfeger designing and manufacturing its own electrical equipment—the *only* shovel manufacturer to do so.
2. **Vastly superior service and parts availability** reflecting our partnership of responsibility to you, the buyers of our products—a partnership of responsibility made possible by our *single source control* of electrical as well as mechanical components and their performance.

Your satisfaction with these advantages has made us The *World's Largest Builder of Full-electric Shovels*. Compare before you buy—write for complete information.

HARNISCHFEGER P&H
Milwaukee 46, Wisconsin

61-585

Visit our P&H Hospitality Suite at Olympic Hotel during A.M.C. Mining Convention—Sept. 11-14, Seattle, Washington

GARDNER-DENVER FL63 FEED LEG DRILL

1. VERSATILITY
Use as a stoper, drifter or sinker.

2. PERFORMANCE
Speed and power under finger tip control.

3. HANDLE-ABILITY
Balanced weight for operator safety. Balanced power for faster drilling.

3 ways better for faster drilling

Gardner-Denver's new, fast-acting, drifter-type valve opens the way to better air flow to the hammer on its FL63 feed leg drill.

Gardner-Denver's new retractable feed leg cuts time for steel changes and new setups. Provides added safety to operator while increasing drilling speed.

Perfect balance of hammer blows and feed-pressure sustains high drilling speeds. Ease of operation is provided by even distribution of weight and by central grouping of all feed controls.

For safety, automatic water gland sends water to the bit before drilling starts—keeps water on until air is shut off.

Gardner-Denver's FL63 feed leg drill has a $2\frac{11}{16}$" hammer diameter, feed travel from 42" to 66". For full details, write for Bulletin 6-6JJ.

GARDNER-DENVER Since 1859

EQUIPMENT TODAY FOR THE CHALLENGE OF TOMORROW

GARDNER - DENVER

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WHY IT COSTS LESS TO OWN A CAT GRADER

Most motor graders *look* pretty much alike, no matter who makes them. They handle similar jobs, too, and it isn't always easy to *see* any big difference in the way they handle them. In fact, the manufacturer's suggested prices usually are not greatly different for machines of nearly equal specifications—regardless of the "deal" that may be offered a buyer. But *used* motor graders vary considerably in price. Why?

The Buyer Determines Price

A used machine is priced at what the buyer is willing to pay . . . it's a measure of what *he* thinks is left in a machine. So, with used equipment, the buyer sets the price. This is clearly demonstrated at used equipment auctions. A check of auction prices throughout the country shows, for example, that the Cat No. 12 Motor Grader brings substantially higher prices than comparable machines of other makes—as much as 80% more. (Only machines of the same age, same condition and with similar attachments were compared.) What makes a Cat Motor Grader more desirable than other makes?

A Feature That Affects Cost

Any machine is desirable if it is known to be dependable. This reputation can only be the result of true quality design and quality construction. The Cat oil clutch is a good example. It was designed and is built to give long, trouble-free life. But, how well does it do it? Let's examine the records of just one Caterpillar Dealer who has 161 oil clutch-equipped motor graders in his territory. His records show that in four years he has sold only $24.38 worth of parts for motor grader oil clutches! One machine in his territory went 2524 service meter hours without any work on the clutch. Many users report 2000 hours of service before the first adjustment. In 1000 hours of operation only about .0025 inch of wear can be expected—less than the thickness of a human hair. And, since all parts are constantly bathed in oil there is no need for lubrication maintenance. Less wear, less attention mean not only lower total repair costs but more time on the job . . . less down time. Of course, the oil clutch is just one example of many quality features in Cat Graders.

A Look at Total Cost Records

The cost records of private owners and governmental bodies show which machines cost less. For example, an Indiana county keeps individual cost records on their six motor graders, 14 trucks, three loaders and five tractors. Their records showed that a year-old No. 12 needed only a set of head gaskets and two spark plugs with $25 labor, while two newer graders of another make needed major engine repairs, new clutches and side shift linkage. One town in New Hampshire reports that in over 20,000 hours, their No. 12 has never had a breakdown that held up work more than three hours. Operating costs—24¢ per hour exclusive of fuel, oil and operator. Comparing a Cat No. 12 to another make (after 3½ years' service), the records of an Arkansas county showed a saving of $2478.57 in parts and labor for their No. 12.

What's in It for You

Others have proved that Cat Motor Graders cost less in the long run because they are built better in the beginning. Your Caterpillar Dealer has additional facts and figures on low-cost operation of Cat Graders in your area. Ask him for free Cost Record Books so that you can keep individual machine records on your equipment. Prove to yourself that it costs less to own a Cat Grader.

Caterpillar Tractor Co.,
General Offices, Peoria, Ill., U. S. A.

CATERPILLAR

Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.

CAPITOL concentrates

GOVERNMENT ACTION AND REACTION AFFECTING MINING

Edmondson Bill Reported In Compromised Form To Help Small Lead-Zinc Miners . . .

The Edmondson bill, H. R. 84, has been reported out by the House Interior Committee in a compromise form. The effectiveness of the bill is scaled down, but its terms are increased far above those of which the Interior Department suggested. For example, the new bill will run for four years against the government's suggested three years. The new bill would cost an estimated $16,500,000 against about $24,500,000 million for the original H. R. 84 and $6,000,000 for Interior's proposal. The difference of $10,500,000 may weigh heavily with the House Appropriations Committee.

The combined lead-zinc price in the original bill was set at 31.5 cents, a figure claimed by the industry to be necessary. The government suggested a figure of 27.5 cents per pound as the basis of the subsidy and the subcommittee compromised on 29.5 cents. In other words, the subsidy would amount to the difference between this figure and the price obtained in the market. Estimates of the total cost of the subsidy obviously depend upon guesses as to what the market prices may be in the next four years.

However, when the bill reached the full Interior Committee to be reported to the House, a disagreement arose about the 29.5 cents combined price formula and a new formula was devised and approved. This formula for computing the subsidy is based upon the government's paying 75 percent of the difference between 14.5 cents per pound of lead and the average price per pound of lead for the month, rather than at the exact time of sale. In the case of zinc the subsidy payment would be 55 percent of the difference between 14.5 cents per pound and the average monthly price of zinc per pound. The effect of this new formula is difficult to calculate and it seems to be unduly complicated.

In accepting the Interior Department's scale-down formula the House Interior Mining Subcommittee either judged that prices will be rising steadily until the mines can operate without subsidies, or it has accepted the "phase-out" idea which may allow death to be a little more painless.

The scale-down in tonnage is illustrated as follows:

	First Year	*Second Year*	*Third Year*	*Fourth Year*	*Fifth Year*
H. R. 84	2,000	2,000	2,000	2,000	2,000
Compromise	1,500	1,200	900	600	
Interior	750	500	250		

Eligible producers under the compromise bill will be those whose combined lead and zinc production is not more than 3,000 tons per year. Newly opened mines would not be eligible.

The Senate, in all probability, will await House action on the compromise H. R. 84 and the Administration's reaction to it before moving ahead with a bill of its own; or it may wait until a bill is passed by the House and sent to the Senate, where passage should not be too difficult. How substantial the aid to the remaining small mines would be under the measure is a difficult question to decide, but it certainly is better than the Interior proposal.

Kelly States Lead-Zinc Policy of Kennedy Administration . . .

The position of the Administration on lead-zinc tariffs and subsidies was clearly stated by Assistant Secretary of the Interior for Mineral Resources John M. Kelly when he testified before the Senate Interior Committee on July 25, 1961. His statement in effect lays down government policy with regards at least to lead and zinc. The policy position can be condensed from the Kelly statement by excerpting a few quotations:

As to tariffs: "It is the considered judgment of the Administration that any weakening of the economies of these countries (those producing lead and zinc), or any alienation of their support, by increased protection to domestic lead and zinc mining would be adverse to the over-all national interests."

As to subsidies: "This hardly seems the way to go about restoring to a sound and stable condition the domestic lead and zinc industry."

As to quotas: "The department believes it would be a mistake to terminate the quotas *at this time.* (Emphasis supplied.) . . . The quotas were never intended to be permanent."

And, in general: "The Administration is simply not ready to concede that the only way in which we can move forward is by resorting to restrictive tariffs or production subsidies." However, "The department is not prepared to propose any alternative legislation at this time."

The above quotes appear to constitute the mineral policy position of the Administration and, although directed specifically toward lead and zinc, there is little doubt but that they constitute a general mineral policy. As a small sop, the Interior Department proposed a very restricted lead-zinc small mines subsidy, one designed to permit the small mines to die easily over a three year period.

Wilderness Amendment Offers Scant Relief For Prospecting and Mining . . .

In reporting the so-called Wilderness bill, S. 174, the Senate Interior Committee added these words about mining: "Nothing in this Act shall be construed to prevent, within national forest and public domain areas included in the wilderness system, any activity, including prospecting, *for the purpose of gathering infomation* about mineral resources which is not incompatible with the preservation of the wilderness environment." Look, child, but mustn't touch!

In fact, the areas set aside could not be mined, even though minerals were discovered, without the express permission of the President.

The Washington opinion seems to be that the bill will pass the Senate, but not the House—at least at this session of the Congress.

Which hole was drilled with BOYLES BROS. equipment?

There's a lot more to diamond drilling equipment quality than meets the eye. Even looking at the finished result, you can't see important factors like drilling speed and power, portability, operating economy, lasting dependability . . . can't tell which equipment will continue giving trouble-saving, profit-making operation . . . and which won't. One thing you *can* look for to protect your equipment investment is the reputation of the manufacturer. For more than 60 years, the Canadian firm of Boyles Bros. have enjoyed world-wide leadership in the manufacture of drilling equipment and diamond bits for core drilling, blast-hole drilling grouting, soil sampling and foundation and oil structure testing. In the field of contract drilling, Boyles Bros. have drilled over ten million feet in the past ten years. **This kind of acceptance HAS to be earned.**

world's largest and most complete diamond drilling service.

WE LOOK INTO THE EARTH

BOYLES BROS
DRILLING COMPANY LTD.,
VANCOUVER, CANADA

Agents: ATLANTIC, GULF & PACIFIC CO. OF MANILA INC., MANILA, PHILIPPINES. AUTOMOTIVE & INDUSTRIAL EQUIPMENT CO., MANAGUA, NICARAGUA. BUREAU TECHNIQUE, DIMITRY SCALISTIRI, ATHENS, GREECE. DR. ALBERTO BIANCHI, MILAN, ITALY. CIA. MINERA "DIAMANTINA B-H" S.A., LIMA, PERU. CODY FEGUSON LTD., TAUPO, NEW ZEALAND. FAGRO, G.m.b.H., HANOVER, GERMANY. FORMAC S.A., FORNECEDORA DE MAQUINAS, RIO DE JANEIRO, BRAZIL. HAEHRE & CO. A/S, OSLO, NORWAY. ITEC, S.R.L., BUENOS AIRES, ARGENTINA. JOHANSSON & CIA, S.A., LA PAZ, BOLIVIA. OY GRONBLOM AB., HELSINKI, FINLAND. WIESE & CA. LDA., LISBON, PORTUGAL. G. WILLIAMS & CO., PRIVATE LTD., BOMBAY, INDIA.

Canada: EDMONTON, ALTA. • YELLOWKNIFE, N.W.T. • TORONTO (WESTON) ONT. • PORT ARTHUR, ONT. • NORANDA, QUE. MONCTON, N.B. • Overseas: NEWCASTLE-UPON-TYNE, ENGLAND • JOHANNESBURG, SOUTH AFRICA • KITWE, NORTHERN RHODESIA • SALISBURY, SOUTHERN RHODESIA.

61-59

IF YOU WANT SUPERIOR PRECIPITATOR PERFORMANCE

A precipitator is a lifetime purchase. Once it is installed, you must live with it, whether you like its habits or not. Because of that Buell urges you to look for the following features when you are making the major investment represented by an electric precipitator.

CONSTRUCTION

1. Custom designed, flexible—Buell helps you determine your precipitator needs, then designs a unit specifically for your requirements. Since Buell SF Precipitator sizes change by only 16" increments, you can get exactly the size you need, without compromise of size, space, and cost.

2. Simplified erection—Modern construction and assembly-marked components and a design that facilitates simple installation, make Buell SF Precipitators easy to erect without specialized contractors. Erection is supervised by Buell engineers, to ensure satisfactory operation.

3. Rugged construction—Simple, rugged construction gives you high efficiency, combined with negligible maintenance costs.

GAS FLOW

4. Uniform gas distribution—Buell designs the entire gas system for its precipitators—including connecting flues with adjustable turning vanes if needed. In addition, at the inlet, special field-adjusting baffles ensure uniform flow across the entire face of the unit. Buell has complete laboratory facilities to determine dust or gas flow pattern with specially constructed three dimensional precipitator models.

ELECTRICAL SYSTEM

5. Fool-proof power supply—Buell silicon rectifiers are compact, lightweight, highly efficient. They need no maintenance—another reason for the top performance of a Buell SF Precipitator.

6. Rigid suspension—The emitting frame of a Buell SF Precipitator is hung from four temperature and shock resistant quartz insulators, each sealed in an individual heated compartment. With this rigid system, electrical distance from emitting to collecting electrode is held constant. This produces uniformly high emission for peak efficiency.

7. Peak emission—Exclusive Spiralectrode® emitting electrodes are fixed top and bottom to the emitting frame. Self-tensioned and permanently aligned, they present areas of maximum emission per unit of power input. Top emission can be maintained with maximum applied voltage, because Spiralectrodes eliminate misalignment.

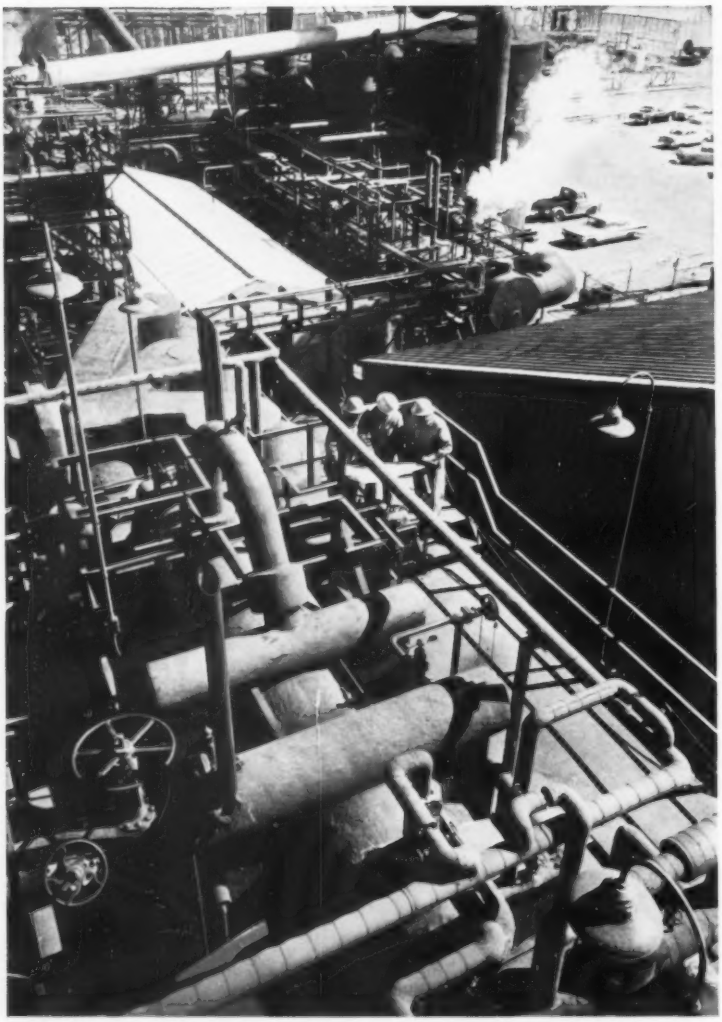
8. Minimum maintenance—The common maintenance headache in most precipitators is frequent replacement of emitting electrodes. Because of rugged suspension and patented electrode design, Buell's 10-year replacement record in this critical area is under 2%.

RAPPING

9. Effective rapping—avoids reentrainment—Buell mechanically raps one row of electrodes at a time, in a continuous cycle. Special pockets in collecting electrodes, and section-by-section rapping in the direction of gas flow, ensure against reentrainment.

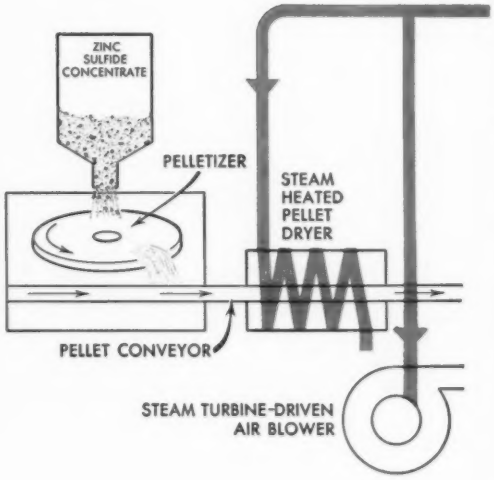
You're sure to be pleased with the superior performance and minimum maintenance you'll get with a Buell SF Precipitator! Buell Engineering Co., Inc., Dept. 66-I, 123 William St., New York 38, N. Y. electric precipitators · cyclones · bag collectors · combination systems · classifiers. **Member Industrial Gas Cleaning Institute**

buell Norblo



High output is maintained by water-cooled roaster surfaces which keep boiler tubes slag free, reducing down-time in this B&W waste-heat boiler at Sherbrooke Metallurgical Co. Ltd.

Process steam economically dries and heats the zinc sulfide ore pellets after they are formed on this pelletizer.



Integrated, efficient boiler-roaster system provides

HIGH OUTPUT, LOW OPERATING COST PLUS REVENUE FROM

Working closely with New Jersey Zinc Company and Matthiessen & Hegeler, B&W engineers integrated two B&W waste heat boilers with patented Fluid Column Roasters developed by New Jersey Zinc. The result: a highly efficient integrated boiler-roaster system now in operation at Matthiessen & Hegeler's subsidiary, Sherbrooke Metallurgical Company Limited at Port Maitland, Ontario.

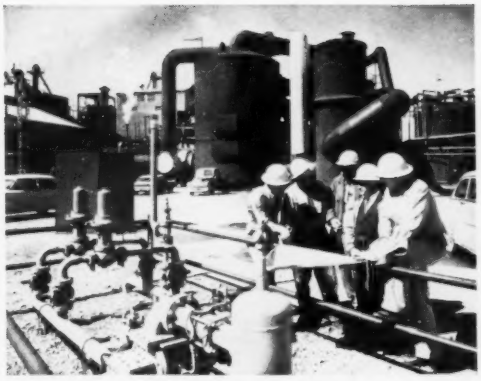
LOW OPERATING COSTS Design of the roaster permits efficient utilization of the "self-burning" characteristic of zinc sulfide ore, eliminating the need for any fuel input except during startup. Process steam generated in the B&W boilers is used to dry the zinc sulfide pellets and drive the fluidizing air blowers and other auxiliary equipment.

Heat-wasting methods of process temperature control are eliminated by maintenance-free, water-cooled B&W tubular surfaces in the roaster enclosure which replace costly, high-maintenance suspended refractory roofs and flues. It is believed that the waste heat recovery, in pounds of steam per pound of ore roasted, sets a new record.

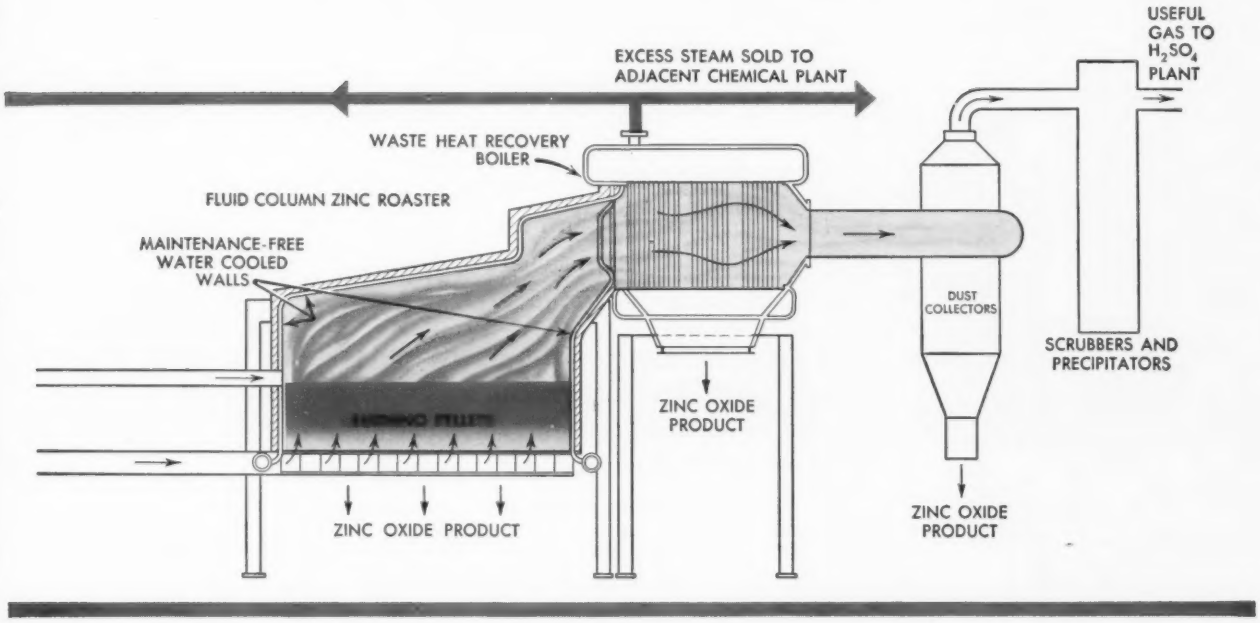
Erosion is prevented and fluid bed cooling is assured by securing protective blocks to the steam generating tubes below the fluid bed level.

A gas and dust tight enclosure capable of sustaining all process pressure fluctuations is provided with B&W's inner casing design of externally-insulated steel plate welded to the boiler tubes. Canadian

Low operating cost results from self-burning characteristic of ore. Initial fuel firing is provided at start-up by the conventionally fueled burners shown above.



By-product revenue is derived from sale of steam and sulfuric acid to neighboring plants. Recovered SO_2 is converted to sulfuric acid in this acid plant.



BY-PRODUCT RECOVERY *at Matthiessen & Hegeler*

winter weather poses no problems for these outdoor units, as all steel surfaces contacted by roaster gas are maintained at temperatures well above the corrosion level.

BY-PRODUCT SULFUR RECOVERY REVENUE SO_2 gas created in the roasting process is recovered and converted to sulfuric acid. Additional revenue is realized through the sale of this by-product.

These two new units are the 22nd and 23rd B&W boilers purchased by Matthiessen & Hegeler since 1873.

With advanced engineering developments such as this, B&W – in cooperation with industry throughout the world – is applying the latest engineering developments to reduce processing costs and increase the recovery of useful energy. For more information on effective recovery of waste heat, write for Bulletin G-88. The Babcock & Wilcox Company, Boiler Division, Barberton, Ohio.

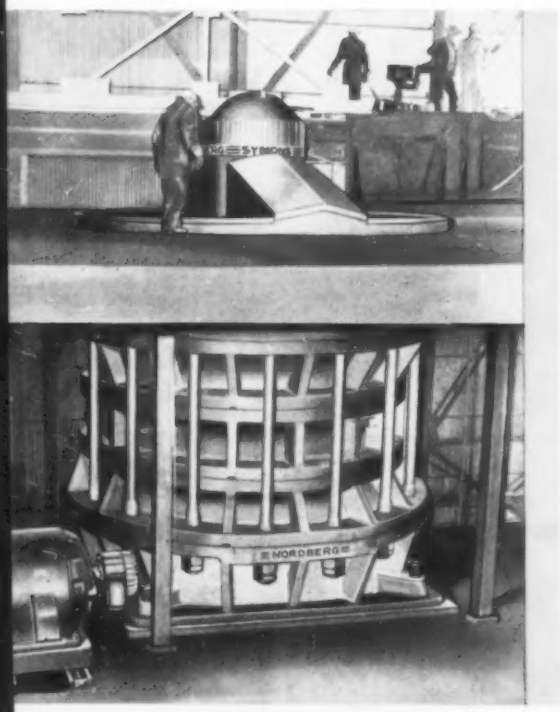
B&W

THE BABCOCK & WILCOX COMPANY
BOILER DIVISION

Users repeatedly specify

NORDBERG MACHINERY

for reliable, low cost production of ORES and MINERALS



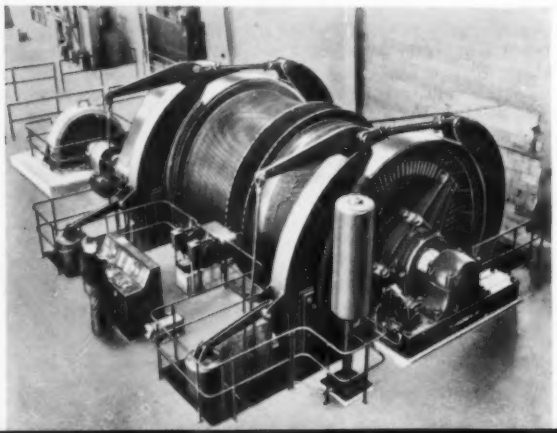
Your interest in lowering the cost, improving the quality, and raising the production of metallic and non-metallic ores and industrial minerals is a mutual interest which Nordberg has shared with the mining industry for 75 years.

This common interest and the many years of broad, yet intimate experience with the mining fraternity is reflected in the effectiveness and quality of Nordberg mining machinery. It is because of this background that Nordberg continues to lead in the design and construction of mining machinery which is *consistently first choice of the world's leading ore and mineral producers.*

SYMONS . . . a registered Nordberg trademark known throughout the world.

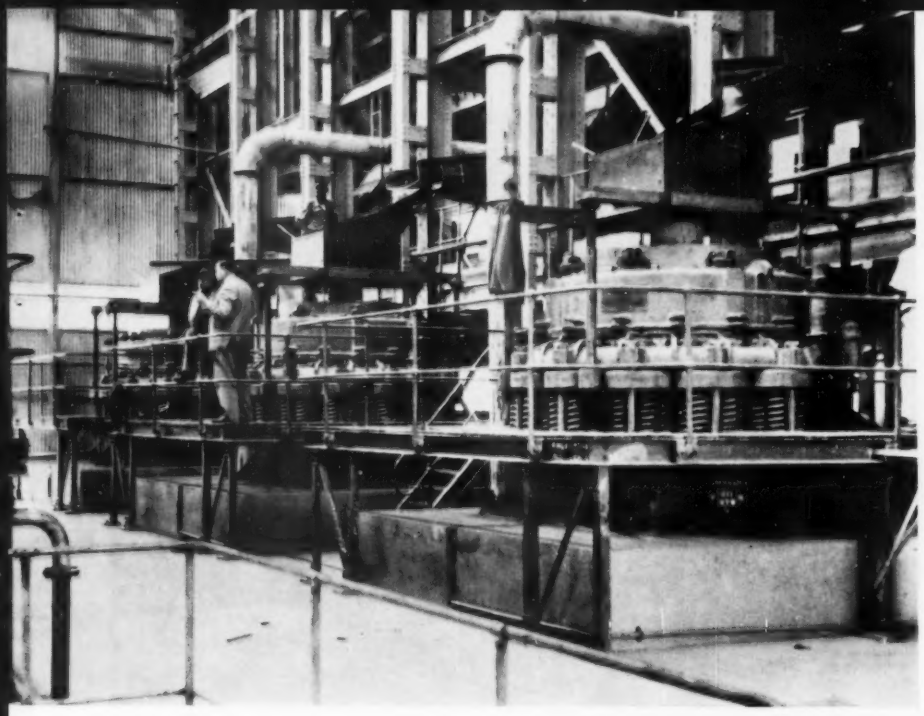
FOR PRIMARY CRUSHING OF MOLYBDENUM

This 60″ Symons Primary Gyratory Crusher has seen several years of service in the primary breaking of "moly" ores in Colorado. Other heavy duty Symons Gyratory Crushers are built with 30″, 42″, 48″, 54″ and 72″ feed opening widths and for capacities to 3500 or more tons per hour.



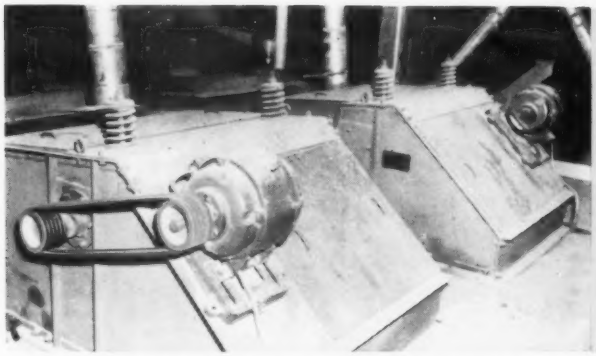
FOR HOISTING IRON ORE

Nordberg Mine Hoists for men and material are built in both conventional drum types as well as friction types . . . for push-button semi-automatic, fully automatic or manual control. Shown is a typical conventional double drum hoist.



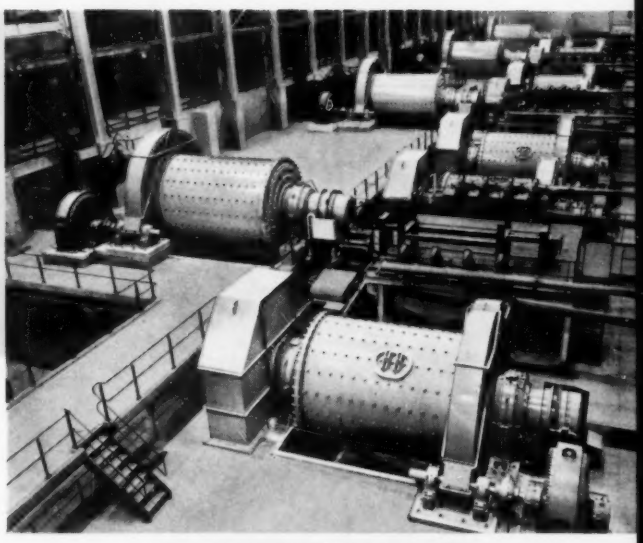
FOR FINE REDUCTION CRUSHING OF COPPER

These three Symons Cone Crushers are serving a Northern Rhodesian copper mine installation. Used for low cost, continuous production of quality products, Symons Cones are first choice of major producers the world over, in capacities to over 1500 tons per hour.



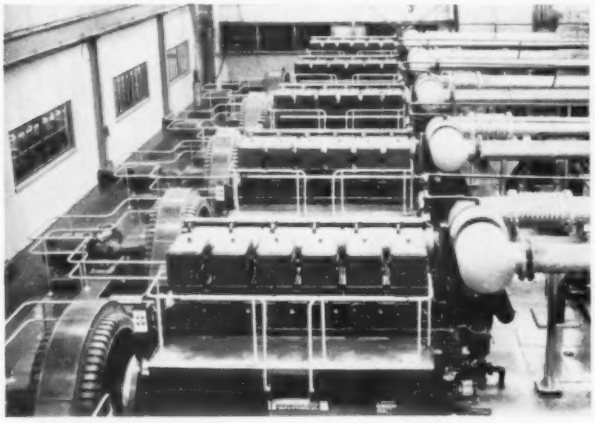
FOR SCREENING URANIUM ORE

These two 4′ x 8′ Symons Rod Deck Screens serve a large uranium processing operation in Canada. Other Symons Vibrating Screens are built in a wide range of types and sizes to handle numerous ore and mineral separation jobs from scalping to fine screening.



FOR GRINDING TACONITE

Shown are but a few of the many Nordberg Grinding Mills being used to reduce hard, abrasive taconite iron ore to the fineness of flour. Nordberg mills include Rod, Ball, Pebble, Tube and Compartment types, in sizes to 13′ in diameter and up to 50′ in length.



FOR POWER GENERATION

Nordberg 2-cycle and 4-cycle diesel, Duafuel®, and spark-ignition gas engines are reliably serving the mining industry in many parts of the world. Sizes range from 10 to over 12,000 hp in a single engine.

NORDBERG MANUFACTURING COMPANY • Milwaukee 1, Wis.

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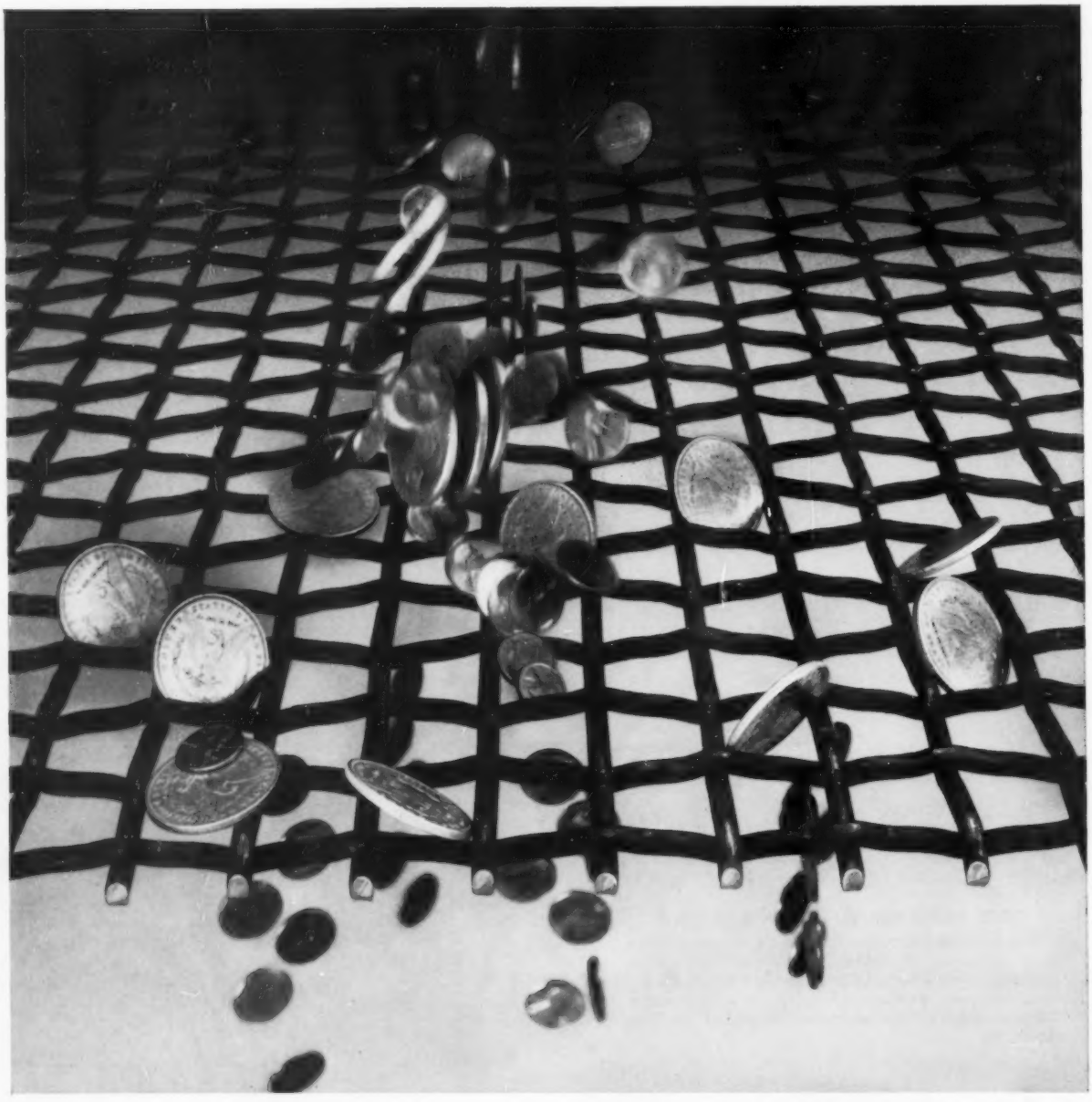
M191



This screen never passes the buck

When you use CF&I Space Screens, you'll find your costs will be reduced from "dollars" to "pennies."

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Magnetorque equipped P&H electrics

CRAIGMONT MINES LTD., uses three 4½-yd. P&H Electric Mining Shovels to move 1,700,000 tons of overburden and ore during first 2½ months on the job.

The new mine, 9 miles west of Merritt, is the first major base metal ore deposit found in British Columbia in 40 years. To work it, Craigmont Mines purchased three P&H Electrics. They are very pleased with the production obtained to date. It has exceeded estimates by an average of 25%.

20 to 25 Second Work Cycles

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On the job, the P&H Electrics get full dippers every pass. It's due primarily to exclusive Magnetorque. This A.C. motor direct-driven, eddy-current coupling provides higher bail pull . . . delivers the P&H Electrics' exceptional digging power at uniformly high speed during the dippers entire pass through the bank. And it does so without need for dipper mani-

P&H Magnetorque Hoist Drive automatically provides higher bail pull, extra power to meet increasing resistance in the bank and maintains uniformly high dipper speed while digging.

P&H Static Electronic Control responds instantly . . . provides fast, precise spotting and highest productivity.

exceed output expectations by 25%

pulation to avoid stalling. Result—faster digging and better fill factor.

P&H Electrics Highly Recommended

In addition to price and delivery, prime factors in the selection of these P&H Mining Shovels to supply this 4,000 ton-per-day mill included: favorable recommendations from other owners about the performance of their P&H shovels, as well as favorable comments about the speed and reliability of P&H parts and service.

Before you buy an electric mining shovel—make sure you've compared all performance factors. For more information on the Craigmont operation, write for Case History Report No. 150 to Harnischfeger, World's Largest Builder of Full-Electric Shovels.

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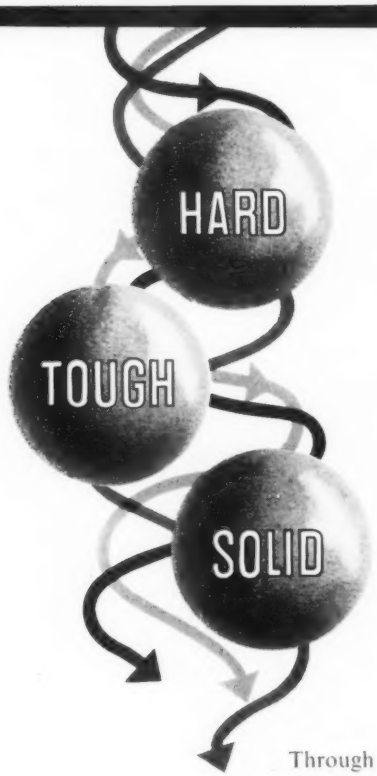

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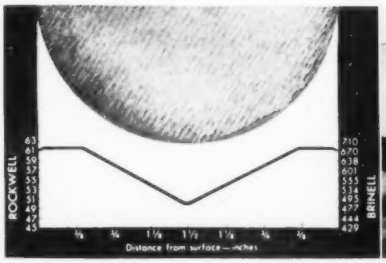
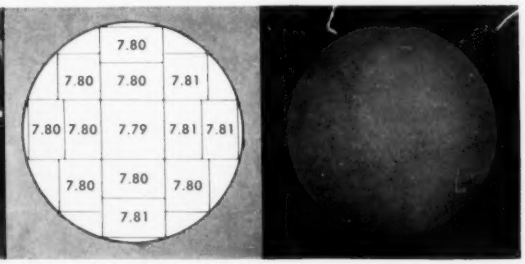


HARD. Curve shows controlled hardness between surface and inner core. Figures are average hardness of samples taken from representative production runs.

TOUGH. Naco Balls resist breakage longer because of close metallurgical control in electric furnaces . . . quality controlled pouring into special molds . . . careful heat treatment.



UNIFORM SOLIDITY. Grid, at left of X-ray photograph of Naco Ball, shows average specific gravity of various sections. Figures are from 169 three-quarter inch sections from 13 production balls.

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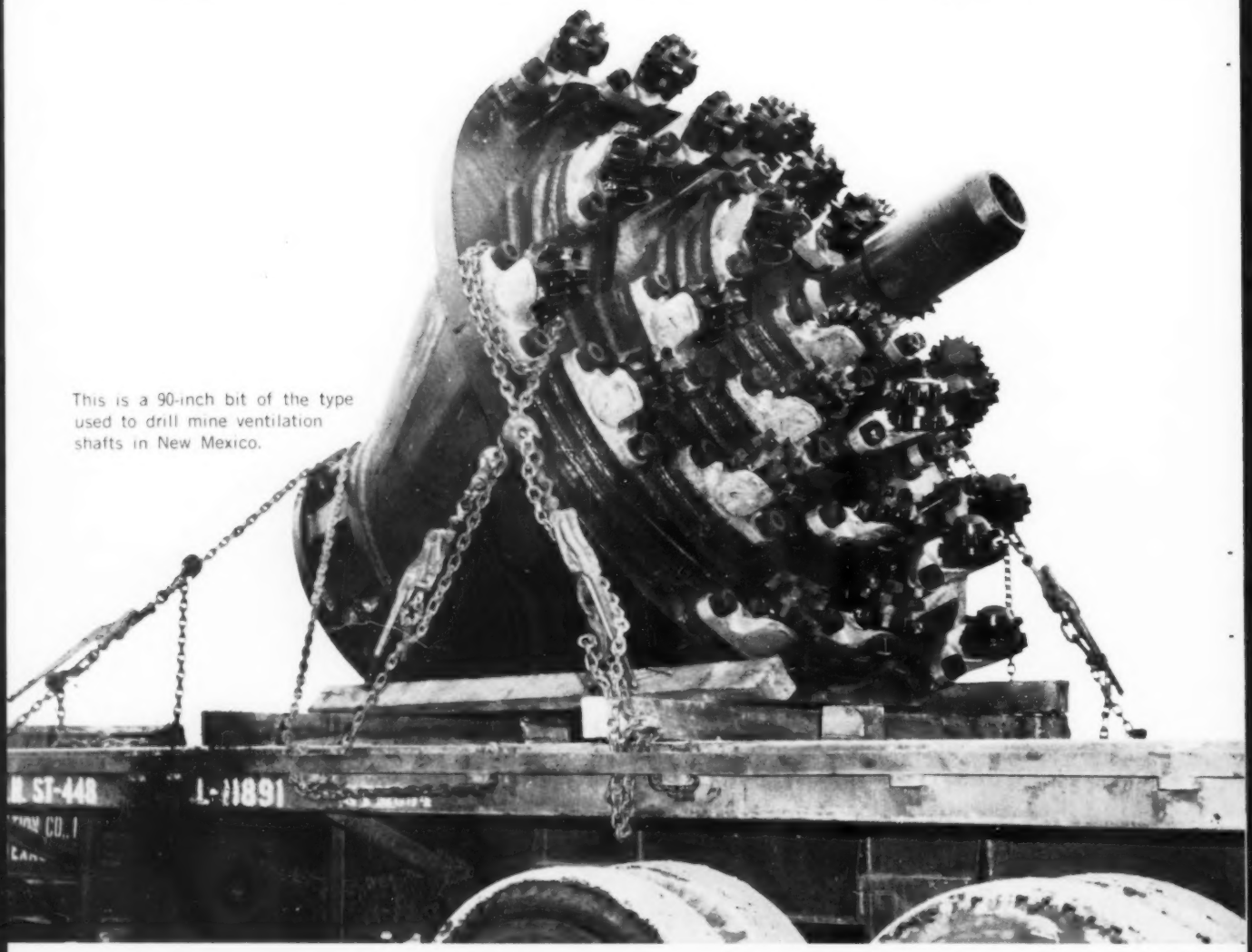
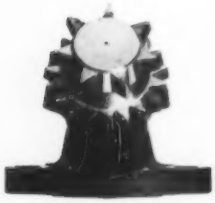


This is a 90-inch bit of the type used to drill mine ventilation shafts in New Mexico.

Hughes offers a complete line of shaft cutters designed to drill specific formation ranges



Type **S**

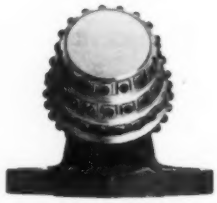
For soft formations, such as calcite, shale, clay, redbeds, salt, broken shale, shells, and soft limestone.

Type **M**

For medium rock, such as shales, sandy shales, and limestone.

Type **MR**

For medium to hard rock with abrasive characteristics such as hard sandy shale, siliceous limestone, dolomite and sand stone.



Type **HH**

For extremely hard, abrasive rock such as taconite, quartzite, granite, flint, novaculite and basalt.

the "bite" for rotary shaft drilling

Hughes cutters and rotary drilling pioneer a new method for sinking shafts

Hughes-developed rolling cutters are being used to drill shafts from 2½ feet to 7½ feet in diameter. Below are some recent examples covering a wide variety of conditions and types of formations from soft to extremely hard and abrasive.

England: Five 36-inch diameter coal mine staple shafts (raises) of varying depths.

California: A number of bridge foundation holes, each 60 inches in diameter and some 145 feet deep, drilled in 50 feet of water across the Martinez Bay for construction of a new bay bridge.

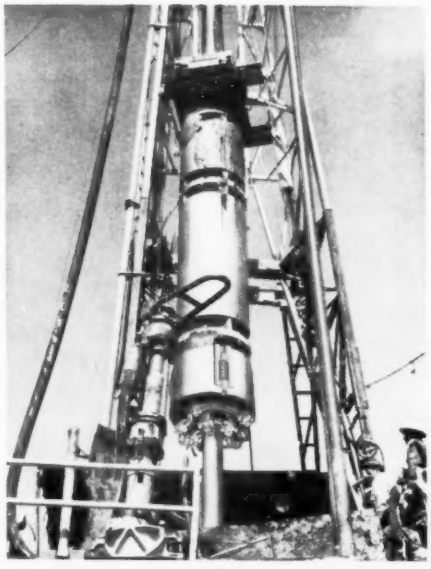
West Virginia: More than 20 ventilation and access shafts, 76 inches in diameter and 500 feet deep, drilled for a number of coal companies.

New Mexico: Uranium mine ventilation shafts, 44, 64 and 90 inches in diameter, ranging in depth from 668 feet to 900 feet.

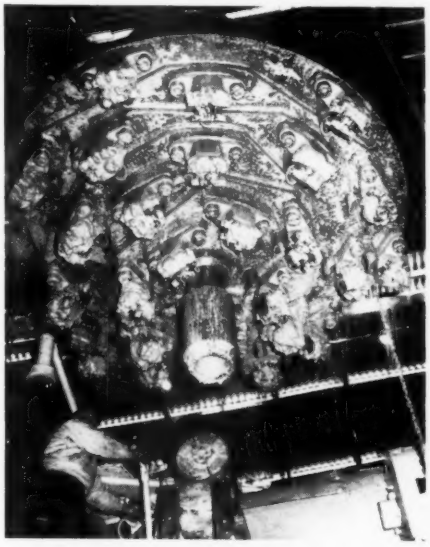
Eastern and Midwestern U.S.: Five 52-inch diameter holes from 300 to 500 feet deep, drilled by several firms for mining underground caverns to store liquefied petroleum gas.

In every case, the rotary method of sinking shafts proved safer, faster, and substantially less expensive than with other methods.

For more information about the rotary method of drilling large diameter shafts or tunnels, contact your Hughes representative or Hughes Industrial Products, Hughes Tool Company, P. O. Box 2539, Houston, Texas.



44-inch bit used to drill a mine ventilation shaft in New Mexico.



View of 90-inch bit as it comes out of the hole, showing 28 Hughes cutters arranged in 7 stages. "Stinger" bit has been removed. Changing of cutters is fast and simple.

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Reprints of illustrated articles about large diameter rotary drilling are available for the asking. Write: Hughes Industrial Products, P. O. Box 2539, Houston, Texas

BERYLLIUM in the news . . .

A special report from Topaz Mountain, Badger Flats, Bernic Lake, Haifa, and Mol

The Topaz-Spor Mountains of western Utah are the scene of the mining rush of the year. The beryllium bearing rhyolitic tuff contains several beryllium rich layers with bertrandite, fluorite, opal, and calcite. Samples have assayed from 0.25 to 1.5 percent B_eO. This tuff bed has been found to be mineralized in a number of areas over several square miles with the best developed prospects on the southwest foothill slopes of Spor Mountain. Erosion has removed this bed on Spor Mountain proper. Low grade reserves in the district have been conservatively estimated at several millions of tons.

The accompanying map shows holdings of five of the largest claim owners in the district. This was compiled from best available data. However, there are known to be many conflicts between boundaries which cannot be shown on this scale. The exact boundaries are not better than a working relation so the map gives only an indication of claim locations. It does, however, show the extent of the claims in about a 70 square mile area.

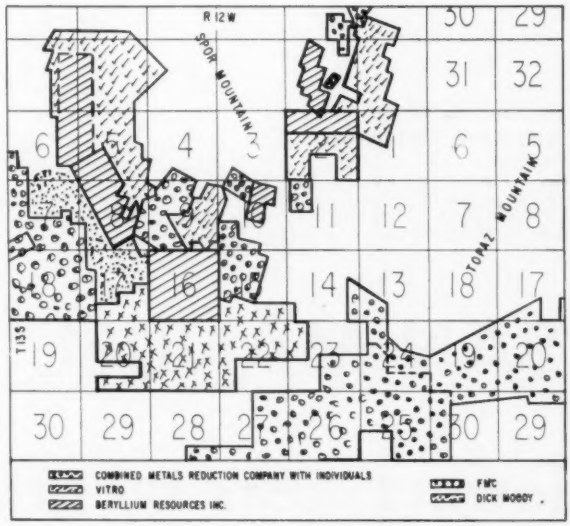
The Topaz Beryllium Venture of Combined Metals Reduction Company with individuals, is one of largest holders. The FMC Corporation (formerly Food Machinery and Chemical Corporation) recently took a lease and option on 126 claims staked by the late John Hedman of Pioche, Nevada.

Beryllium Resources, Inc., one of the district's pioneers owns several claim groups and leases a State School Section. Vitro Uranium Company has claims and a School Section of three sides of Spor Mountain. Other claims are owned, leased, or optioned by United Technical Industries, Inc., and Richard Moody of Delta, Utah.

In mid-June, General Beryllium Corporation of New York announced that it had acquired 250 claims and some state leases in the district.

Two separate processes are now concentrating Topaz Mountain bertrandite ore. United Technical Industries with Beryllium Corporation is making metallic beryllium using an inorganic chemical leaching process to produce beryllium oxide which is then reduced to the metal. A new mill at Delta, Utah has a 25,000 pound per month oxide capacity. Beryllium Resources, Inc. in association with Brush Beryllium Company has developed a flotation process to upgrade the Topaz Mountain bertrandite ore before conversion to metal.

Colorado's Badger Flats district may be open pitted adjacent to the Boomer mine reports the U. S. Beryllium Corporation. The mine has produced several thousand tons of high grade beryl and bertrandite ore from hydrothermal veins. The company is now mining and shipping a ton of 8.0 percent plus B_eO ore daily to the Mineral Concentrates and Chemical Company's Loveland, Colorado flotation mill. U. S. Beryllium has stockpiled more than 1,000 tons of lower grade ore at its

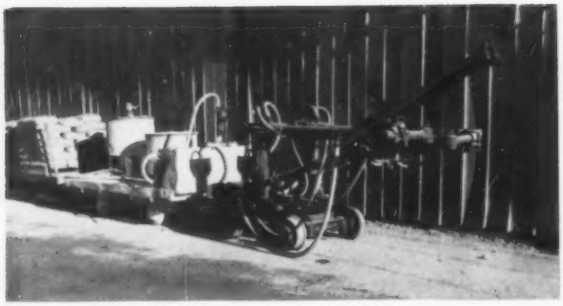


mines which will be milled in the new 100 ton per day mill which Mincon is building at Badger Flats.

Bernic Lake, Manitoba reportedly is the location of one of Canada's greatest beryl reserves. Chemalloy Minerals, Ltd., has found low grade (0.15 percent) beryl in its large pegmatite by diamond drilling. Chemalloy has large reserves of pollucite (cesium) in the pegmatite. A flotation mill using a Canadian process is planned to recover the beryl.

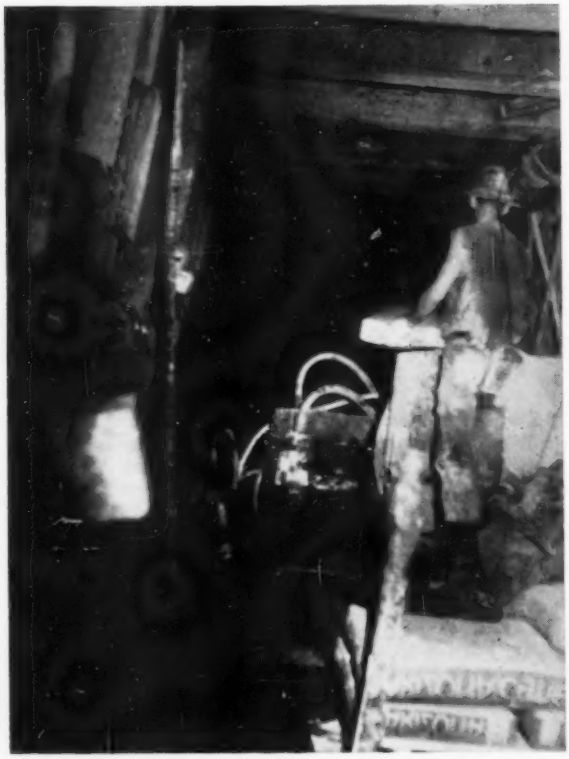
Haifa, Israel is the scene of experimental work for the heavy liquid recovery of beryllium minerals by the tetrabromoethane process. Experiments have shown that separate beryl and bertrandite concentrates can be obtained from a pegmatite ore. Beryl is recovered at a specific gravity from 2.634 to 2.722 while the bertrandite is separated at less than 2.634 gravity.

Mol, Belgium is the scene of a new atomic research and test reactor using a special 43-inch diameter core fabricated with about $1,000,000 worth of beryllium. The specially machined hexagonal beryllium bars were made by the Brush Beryllium Company of Cleveland, Ohio. The core holds enriched uranium in aluminum tubes, control rods, and water coolant elements. Beryllium is used because of its desirable neutron, thermal, and structural characteristics. It acts as a slight moderator and spacer between the uranium and aluminum clad cadmium control rods. Use of beryllium in reactors is increasing and for the first time is used as a reflector in the Windscale gas cooled power reactor in England. Successful use there will open up additional markets.



MOBILE GROUTING equipment consists of cement flat car, 50-gallon mixing tank with an air motor, cement receiving tank, grout pump, and drill jumbo with a three-inch drifter. Grouting crews consist of only two men.

by **John R. Bogert**
Field Editor, MINING WORLD



DRIFT REPAIR accounts for most of grouting at San Manuel with crews placing mixture overhead between timber sets.

SAN MANUEL

lowers costs by grouting bad ground

The San Manuel Copper Corporation uses a unique method of pressure grouting to stabilize highly fractured or broken ground at its San Manuel mine in Arizona. This is one of the first mines in the United States to use grout extensively for strengthening and stabilizing drifts, shafts, and other underground workings. The results have been less delays in development and production, lower costs and safer working conditions.

Pressure grouting has three distinct uses in the mine: (1) on approaching a known large zone of broken ground, grouting is placed ahead and on all sides, and then the drift is driven through the grout pattern; (2) after the drift has crossed a small fracture or fault zone, grouting is placed overhead and on the sides to seal off running ground and (3) in drift repair where loose or fractured rock continues to give trouble in spite of timber or steel supports.

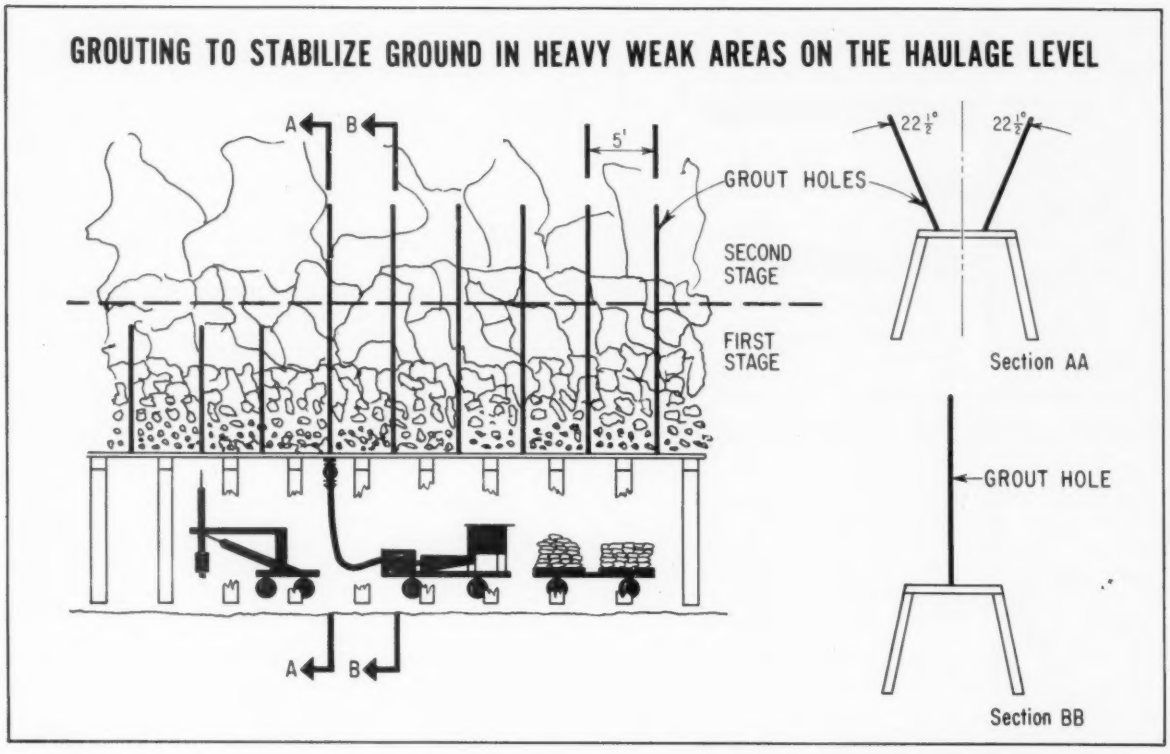
The use of grouting at San Manuel complements the extensive use of concrete used for underground support, (See MINING WORLD, October 1960). In development work through bad ground, grouting is used as an aid for excavating, while concrete is used for permanent support after excavation is complete. In drift repair, grouting is an actual repair medium reducing ground movement and giving it more structural strength; while concrete is used to support ground too heavy for grout and timber. If the ground is exceptionally heavy, grout is used to further consolidate the rock and reduce ground movement after concrete support has been placed.

Pressure grouting is any process of pumping a controlled mixture of water and cement with a small amount of bentonite additive into fractured, shattered or porous rock. Depending on the nature of the rock and other conditions, the ratio of water to cement varies from a thin mixture of 30 gallons of water to a sack of cement to a very thick mixture of 5 gallons of water to a sack of cement. The thin mixture would be used for the very fine fissures, and the thick mixture for large fractures and the more extensive shattered areas. The use of bentonite with the mixture improves plasticity and reduces shrinkage of the grout.

At San Manuel grouting is done only when required. There are from two to six grouting crews (depending on the amount of work) with each crew composed of two men. Each of the crews is equipped with a drill jumbo, mixture tank, cement receiving tank, and a grout pump. All the equipment is track mounted to permit maximum mobility underground.

Grouting has become standardized. Grout holes are drilled with three-inch drifters on one-boom jumbos, using five-foot lengths of 7/8-inch hexagonal sectional steel and throw-away bits. Collar pipe holes are 2 3/8-inches in diameter, and the regular grouting holes 1 1/2 to 1 7/8 inches in diameter—depending on the nature of the rock.

Cement is delivered to the working area on flat cars holding two pallets of 30 sacks each. The pallets are loaded at the Arizona Portland Cement Company at Rillito, and the sacks are not handled by hand until



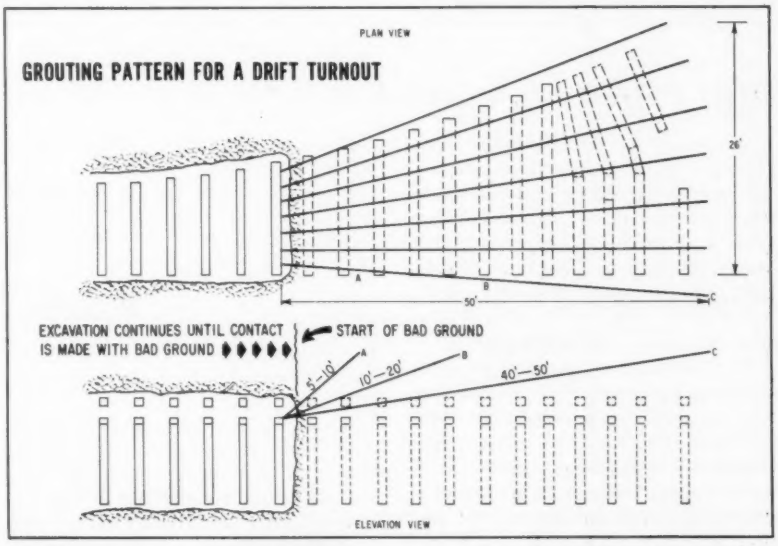
STABILIZING ground in heavy, weak areas on haulage levels was first use of San Manuel grouting methods. From this, procedures were developed to use grouting in shafts, drifts, turnouts, and development areas. **Figure No. 3.**

their contents are dumped into the underground mixing tank. Cement consumption averages about 22 sacks per crew-shift in shaft station and drift turnover development; and about 63 sacks per crew-shift in drift repair work. These figures vary considerably depending on the nature and condition of the heavy ground.

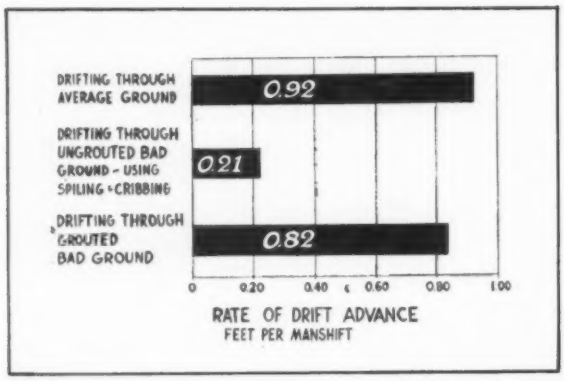
A 50-gallon tank fitted with a rotating paddle is used for mixing cement. An Eimco 201 MG 1 air motor supplies power for the paddle. After the cement is mixed, it is discharged into the 50-gallon receiving tank, which acts as a surge tank between the mixing operation and the grout pump. The receiving tank also permits easy removal of any chunks of hardened cement that would clog the grout pump.

Modified Gardner-Denver 6- by 2½- by 6- inch FG-AG grout pumps are used that can handle approximately 14 gallons of grout solution a minute at an output pressure of 500 pounds per square inch. The pumps are used either singly or in series, depending on the pressure required. Generally, pumping pressures vary from 100 to 1,000 pounds per square inch according to the compactness of the rock, and the pressure of the ground water encountered.

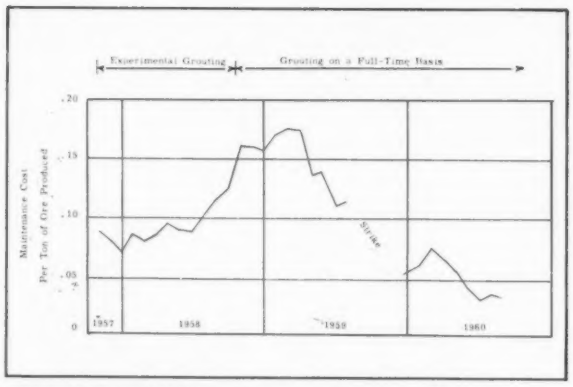
San Manuel is continually developing new mining areas preparatory to block caving, and irregular zones of loose, shattered rock are found in many of these areas. Before the present grouting system was initiated, driving drifts and sinking shafts in zones of incompetent ground frequently required the use of cribbing, spiling, and, occasionally, breast boarding. The placement of such extensive support always slowed down development work and often increased costs considerably. Now however, when drift or shaft development runs into bad ground, work is stopped until the area can be grouted. As soon as the grouting is completed, excavation work is resumed with an approximate 50 percent decrease in lost time and costs. **continued on page 24**



GROUTING pattern for typical drift or turnout in broken ground. **Figure No. 1**



DRIFTING rates in a 10- by 10-foot timbered haulage drift on the 2075 level of the San Manuel mine. **Figure No. 2.**



DRIFT MAINTENANCE cost per ton of ore produced shows a substantial drop after introduction of pressure grouting.

The procedure for grouting a typical drift or turnout in bad ground is shown in Figure No. 1.

At the face of the drift, the gaps between the cribbing or lagging are chinked with empty cement sacks to prevent leakage of grout. Grouting of the proposed turnout is then accomplished in two stages. The broken and caved rock is first drilled and grouted to a depth of 5 to 10 feet—depending on the depth of broken rock. This preliminary grouting forms a seal so that higher pressures used beyond 10 feet will not cause excessive leaks at the face. No more than one hole is drilled and grouted at a time, thereby eliminating the possibility of the grout solution plugging up nearby drill holes. A pipe 10 feet long is inserted in the drill hole and wedged tightly with empty cement sacks. Grout is then forced inside the pipe until the pressure reaches 200 to 300 pounds per square inch. The pipe is then removed if possible. Experience has shown that five or six holes are usually adequate for the first 10 feet of grouting.

In the second stage, longer holes up to a depth of 40 or 50 feet are drilled through the previously grouted rock. The grouting procedure described above is then repeated, but pressures are allowed to build up approximately to 500 pounds per square inch—the capacity of one grout pump. After all holes have been grouted, excavating proceeds as usual, though reasonable care must be taken during blasting.

To induce higher grouting pressures requiring two or more pumps, additional preparation is necessary. Larger diameter holes are drilled five to seven feet deep, and a two-inch collar pipe grouted in so that it will not blow out or leak under pressure. The first and second stage holes are re-drilled through the pipe to the desired depth. By using 800 to 1,000 pounds pressure per square inch, instead of the normal 500, penetration is increased by approximately 30 percent, and cement consumption is increased from about eight sacks per hole to eleven.

Without grouting the average time required to excavate a turnout in bad ground is about 21 days (three shifts per day). In contrast, the average time required to excavate a turnout utilizing grouting procedures is only about 14 days—a time saving of about 33 percent!

Besides speeding up excavation work at turnouts, grouting also shortens the time required for driving drifts. A good example is the experience of a drift crew on the 2075 level. While driving a haulage drift they encountered particularly bad ground that was intensely fractured by fault movement. At first they attempted to continue mining with the use of spiling and cribbing, but after three days they stopped and let a grouting crew take over. Grouting was quickly done in a few days time, and the crew resumed excavating at nearly the same rate as that which prevailed in competent ground. Figure No. 2 gives a comparison of these drifting rates.

Drift repair minimized as well as made easier and safer

The grouting procedure at San Manuel was originally developed to minimize drift repair, and to relieve the problems caused by weak moving ground. From this beginning, the uses of pressure grouting have broadened considerably. However, drift repair still accounts for most of the grouting work done in the mine.

The block caving method of mining produces great pressure on adjacent uncaved ore, which causes it to compress and undergo plastic deformation. Accordingly, timber and steel supports cannot hold it above the haulage drift for a very long period of time. Supports must be changed and reinforced continually. In time, considerable arching occurs in the ore above, and with further ground movement the ore crumbles into broken rock. This makes timber repair difficult and hazardous; and, in addition, rock will often spill into the drift below blocking ore trains and restricting ventilation. By grouting this broken material, ground movement is retarded, and drift repair minimized as well as made easier and safer.

The consolidation of ground above drifts is accomplished in two 10-foot stages, producing 20 feet of grouted rock. The first stage is the drilling of two 10-foot holes into the back of the drift at an angle of 22° from the vertical. This drilling is alternated every five feet along the drift with a single 10-foot vertical hole. All of the holes are grouted as described before. In the second stage the 10-foot grouted area is redrilled with 20-foot holes in the same pattern, and the area regrouted providing a total of 20 feet of grouted ground. See Figure No. 3.

When this overhead grouting was first attempted in drift repair, 20-foot holes were drilled in one stage. However, loose ground made it very difficult to keep the holes open long enough to insert the grouting pipe, so this procedure was discontinued.

Only one hole at a time is drilled and grouted. As is customary in development work, grout is pumped into the hole until it will not take any

more, until a leak develops, or until it is thought grout is being wasted in a large void. At times when grout will not enter the rock, the 10 foot long grout pipe is pulled back two feet and pumping attempted again. This procedure is continued until the grout effectively penetrates the rock or until the pipe is withdrawn from the rock. Usually a 5 to 10 foot radius is grouted around each hole, which forms an effective overlay of consolidated rock. Approximately five linear feet of drift are grouted by a two-man crew each shift.

Shaft stations in wet, shattered ground are excavated with a minimum of delay, and greater safety after pressure grouting

Besides using grouting in drifts and other horizontal workings, the procedure has been successfully applied to consolidating ground prior to excavation of shaft stations.

The drilling pattern used for grouting a shaft loading station is similar to that used in drift development. The highly fractured rock in this particular area was yielding about 1,300 gallons of water per minute. Grouting proceeded as described previously, but the pressure used did not exceed 500 pounds per square inch. This was because the rock was so badly shattered that greater pressure pushed the grout through the fissures back into the shaft. Some 15 sacks of cement were pumped into each hole, but in the end, the ground was consolidated and the flow of water effectively stopped. Some time later, while the station was being excavated, hardened grout was frequently seen in large gapping fissures and seams. This was good evidence that without grouting, the station would have been completed only after many delays and possible injury to the men. After excavation was completed, and the loading station completely concreted, the walls were further stabilized and waterproofed by re-grouting through the reinforced concrete lining. Most of these re-grout holes were 10 feet long, fanned out in horizontal rows six feet apart.

For a large rotary dump station, where the rock contained many streamers of clay and silt, the grout pipes were cemented in and grout applied to 800 pounds per square inch pressure. After grouting was completed the station was excavated with no difficulty, and again, large fissures were seen filled with solidified grout. Cement consumption averaged eight sacks per hole, but the use of grouting resulted in the need for less concrete for permanent support.

Development of transfer raise stations above haulage drifts are also speeded with grout. Frequent ground movement (requiring timber repair) leaves a large amount of loose rock around the drift excavation. By grouting the surrounding area before excavation begins, the raise station crews can drill and blast in consolidated ground without creating excessive and hazardous overbreak.

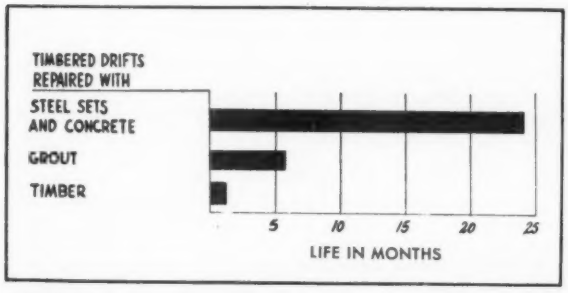
Drift repair costs vary according to underground conditions

To determine whether timber, grout, or concrete will be used to repair timbered drifts, three factors are considered: (1) the length of time that the drift will be used; (2) severity of the ground weight; and (3) the ability of the ground to take grout. The most economical method of repair is always the one with the lowest initial cost which will last without replacement for the useful life of the drift. A comparison of the costs, and support life of the concrete, grouted ground, and timber are shown in Figures No. 4 and 5.

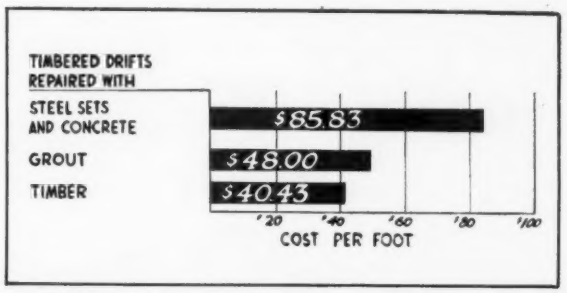
Grouted haulage drifts do not have as long a support life as concreted ones in heavier ground. However, in most cases the grouted drifts hold up as long as needed, and so are more economical than concreted ones. Also, grouting saves more time since repairs can be made faster as no forms or supports are needed, and no removal of loose rock above sets is required.

The need for grout for repair in the San Manuel mine is generally diminishing since more and more concrete is now being placed initially instead of timber in areas where high rock pressures are anticipated. Concrete provides stronger support over a longer period of time, and it can be placed in areas that will take weight in the future but initially are too compact or uniform to take grout. However, pressure grouting is being used more frequently as an aid in development excavation, and new applications are being recognized continually. Thus, it will probably occupy an important place in mining at San Manuel for years to come.

MINING WORLD wishes to thank the management of the San Manuel Cooper Corporation, and particularly C. L. Pillar, mine superintendent, and Mr. M. J. Coolbaugh, research engineer, for their help in preparing this article. END



EFFECT of extreme ground pressure on life of support in haulage drifts. Use of timber, grout, or concrete depends on length of time drift will be used, severity of ground weight, and ability of ground to take grout. **Figure No. 4.**



EXAMPLES of repair costs in drifts with extreme ground pressure. The most economical method of repair is always one with lowest initial cost which will last without replacement for the useful life of the drift. **Figure No. 5.**

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Gateway to Alaskan Gold

September 10 through 14 are the dates for the AMC's Seattle meeting. Speeches, flower arrangements, a trip to Canada, Bethlehem Steel Corporation's electric-arc furnace steel plant, and Boeing Airplane Company's factory are all on the four day program. All meetings and speeches will be held in the heart of Seattle—the Olympic Hotel. Here are the key events of the four day meeting:

Monday, September 11

EXPLORATION AND GEOLOGY

Chairman: Earl F. Cook, Dean, School of Mines, University of Idaho
Vice Chairman: Peter Joralemon, Consulting Geol., San Francisco
Importance of Research in Creating Mineral Resources
Thomas B. Nolan, Director, U. S. Geological Survey, Washington, D. C.
Geological Development in the Twin Buttes District Near Tucson
Willard C. Lacy, Professor of Geology, University of Arizona, Tucson, Ariz.
Extending Reserves in the Coeur d'Alene District
Rollin Farmin, Asst. Mgr., and Garth Crosby, Chief Geol., Day Mines, Inc., Wallace, Idaho

MILLING AND METALLURGY

Chairman: J. C. Kinnear, Jr., Gen. Mgr., Nevada Mines Div., Kennecott Copper Corp., McGill, Nev.
Vice Chairman: Charles H. Curtis, Asst. Resident Mgr., Copper Div., Duval Sulphur and Potash Co., Tucson, Ariz.
Trends in Mineral Processing Research
Robert J. Brison, Battelle Memorial Institute, Columbus, Ohio
Automation in the Copper Queen Mill
Philip F. Allen, Mill Supt., Phelps Dodge Corp., Bisbee, Ariz.
Application of X-Ray Emission to On Line Control in the Mining Industry
W. F. Loranger, Mgr., Chemical Process Sales, and Rolf G. Edholm, Mgr., Product Planning-Industrial, General Electric Co., Milwaukee
Advances in Copper Concentration Techniques
E. P. Cadwell, Chief Metallurgist, Mining Chemicals Dept., American Cyanamid Co., New York
Heavy Media Cyclones in Iron Ore Beneficiation
William R. Van Slyke, Range Metallurgist, Cleveland-Cliffs Iron Co., Taconite, Minn.

Tuesday, September 12

OPEN PIT MINING

Chairman: Carl G. Hogberg, Pres., Michigan Limestone Div., U. S. Steel Corp., Detroit
Vice Chairman: O. E. Pothier, Dir. of Mining Operations, J. R. Simplot Co., Pocatello, Idaho
Relationship of Fragmentation in Blasting and Crusher Performance
James Carr, Asst. Mine Supt., National Lead Co., Tahawus, N. Y.
New Techniques in Silica Sand Production
Hugh Bein, Mining Engr., Del Monte Properties, Pebble Beach, Calif.
Recent Developments in Open Pit Haulage
E. R. Borcherdt, Partner, Borcherdt & Smith, San Francisco
Use of a Digital Computer in Calculating the Economic Limits of an Open Pit Mine Expansion
James F. Olk, Mine Supt., Pima Mining Co., Tuscon, Ariz.
Open Pit Methods at the Craigmont Mine
Robert Hallbauer, Mine Supt., Craigmont Mine Ltd., Merritt, B. C.

UNDERGROUND MINING

Chairman: A. R. Patterson, Vice Pres. and Gen. Mgr., Knob Hill Mines Co., Republic, Wash.
Dewatering the Grace Mine
G. K. Biemesderfer, Geol., and R. H. Leske, Mining Engr., Grace Mine, Bethlehem Steel Corp., Bethlehem, Pa.

New Automatic Friction Mine Hoist
Carl W. Anderson, Chief Engr., M. A. Hanna Co., Cleveland
Raise Driving at Anaconda
Leonard P. Colvin, Asst. Research Engr., and John Suttie, Mine Supt., The Anaconda Co., Butte, Mont.
Application of Lebus Grooving to Mine Hoists
L. D. Thompson, Chief Service Engr., Lebus International Engineers, Inc., Longview, Texas
Special Cast Alloys for Underground Use
William Barber, Jr., Metallurgical Dept., Esco Corp., Portland, Oreg.

MILLING AND METALLURGY

Chairman: Robert J. Linney, Pres., Reserve Mining Co., Silver Bay, Minn.
Grate-Kiln Pelletizing Process at Humboldt
Robert W. Berkhahn, Operating Metallurgist, and Daniel M. Urich, Pyrometallurgist, Cleveland-Cliffs Iron Co., Ishpeming, Mich.
Direct Reduction by the H-Iron Process
Russell J. MacMullin, Vice Pres., Hydrocarbon Research Inc., New York
Columbia-Geneva's New Ore Testing Laboratory
Milton F. Williams, Mgr., Raw Materials Research Laboratory, Columbia-Geneva Steel Div., U. S. Steel Corp., Provo, Utah
Disposal of Metallurgical Wastes
Frank Day, Gen. Supt., Anaconda Reduction Works, Anaconda, Mont.

Wednesday, September 13

STATE OF THE MINING INDUSTRIES

Copper—James Boyd, Pres., Copper Range Co., New York
Lead-Zinc—Clark L. Wilson, Chairman, Emergency Lead-Zinc Committee, Washington, D. C.
Discussion: Richard A. Young, Vice Pres., American Zinc, Lead & Smelting Co., St. Louis
Light Metals—Walter L. Rice, Pres., Reynolds Mining Corp., Richmond, Va.
Solid Fuels—David L. Francis, Pres., Princess Coals, Inc., Huntington, W. Va.
Industrial Minerals—R. M. Foose, Chairman, Dept. of Earth Science, Stanford Research Institute, Palo Alto, Calif.
Strategic Minerals—S. H. Williston, Exec. Vice Pres., Cordero Mining Co., Palo Alto, Calif.

UNDERGROUND MINING

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Vice Chairman: Earl H. Miller, Resident Mgr., U. S. Borax and Chemical Corp., Carlsbad, N. Mex.
Use of Ammonium Nitrate Explosives Underground
Robert P. Matson, Supt., Midwest Ore Co., Iron Mountain, Mo.
Use of Concrete Mine Supports
Speaker from Consolidated Mining & Smelting Co. of Canada Ltd., Kimberly, B. C.
Use of AC Shuttle Cars at Carlsbad
T. G. Ferguson, Pres., National Potash Co., Carlsbad, N. M.
New Trends in Underground Rail Loading and Tramming
James W. Clark, Lake Shore, Inc., Iron Mountain, Mich.
Texas Gulf Sulphur Company's New Potash Project
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Cable Tramway Automation
Clyde Holen, Plant Engr., Northwest Magnesite Co., Chewelah, Wash.
Panel on Grouting for Control of Ground Water
Lionel A. York, Mining Engr., Cementation Co. of America, Inc., Toronto, Ont.
John Reed, Professor of Mining Engineering, Colorado School of Mines, Golden, Colo.
Victor L. Stevens, Mgr., Mining Div., Boyles Bros. Drilling Co., Salt Lake City
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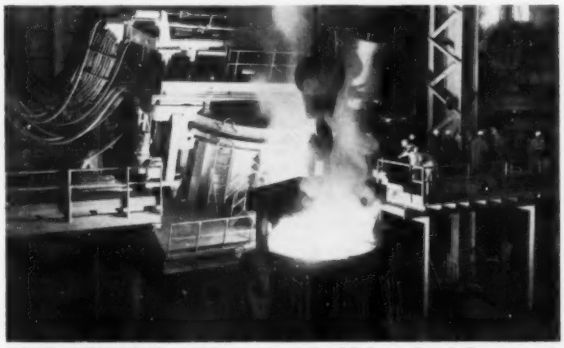


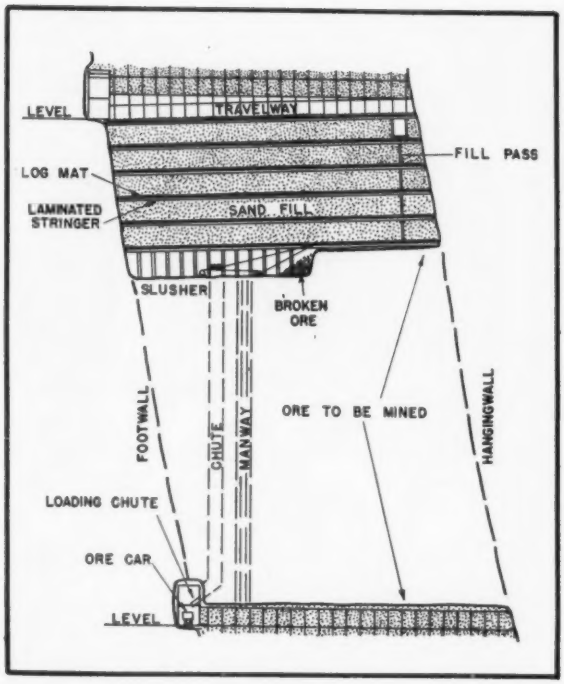
TOUR HIGHLIGHT will be visit to Bethlehem Steel Company's West Seattle electric-arc furnace plant; two new furnaces were installed in 1958. This tap is more than 100 tons.

CONTINUOUS LAMINATED PLANK stringers are built right in the stope. Each is five planks wide with alternate planks staggered on five foot centers. Planks are 1¾ inches wide, 11¾ high and 11 feet long. Stringers are built the total length of each cut. At each joint, 14 by 16 inch steel plates 5/16 of an inch thick are placed on each side of stringer. Four carriage bolts, ¾ by 10 inch, two above the stringer and two below, bolt the plate to the stringer. The miner at left is placing one of the interior planks while the miner at right operates air driven impact wrench to tighten bolts.

UNDERCUT-AND-FILL stoping

ROUND LOG MAT is placed on top of the laminated stringers. Note how the five-plank-wide stringer has been braced in place with spreader and outside blocking to wall. Logs are fitted tightly to walls and end to prevent sand leakage. Note that the bottom of the posts DO NOT touch the top of the stringer. Actually, stringers are altered from inside to outside of posts on successive vertical cuts. Note two inch thick block (lower right) to keep logs off steel plates.

- By cutting timber consumption 40 percent in comparison to square-set mining.
- By reducing unit cost of timber 9 percent per thousand board feet.
- To cut total timber cost 45 percent.
- To raise mining efficiency of undercut-and-fill 25 percent over average square-set efficiency.
- By eliminating bad ground overhead to make possible a much closer prediction of required mining cycle.



TYPICAL CROSS SECTION shows how this new system works. Underhand cut provides solid footing for posts. Ore moves to cars through gravity raises. Fill (mill sand tailing) flows into stopes driven on 4° slope for proper distribution and tight packing with efficient water decantation.

Cheaper Timber to buy and Less Timber to install are keys to success of this new mining method which was designed with these four requirements:

1. *The timber would retain the fill and provide adequate support.*
2. *Simple repetitive timbering methods would be used in every stope.*
3. *The system would use less timber than regular square set stoping.*
4. *Low-cost round logs would replace specially cut dimensional timber.*

saves money at International Nickel

Undercut-and-fill stoping, a new mining method developed by the staff of International Nickel Company of Canada, Limited, is now used to mine 50 percent of the filled stopes at the company's Frood-Stobie mine near Sudbury, Ontario, Canada.

So successful is the new stoping method that it will probably almost completely replace square-setting for pillar removal in the company's operations.

At Frood mine, where its development has taken place over the past several years, the new method has fully demonstrated its effectiveness in mining pillars and other difficult ground. Results have been so satisfactory that its use is being rapidly expanded in normal pillar recovery both at Frood and other Inco mines.

Through the improvements it makes in safe-working conditions and efficiency, undercut-and-fill is also seen as the key to greater utilization of ore at depth in the company's mines, and thus its influence will be felt for generations to come.

Undercut-and-fill is a method of extracting ore by mining successive layers, or cuts, working from the top down. After a cut of ore is completely mined out, continuous laminated timber stringers are constructed along the sides the full length of the cut. Rounds logs are laid across the stringers to form a timber mat and the opening is then tightly filled with water-borne sand fill.

Mining is then resumed on the next lower cut under the mat. As the cut advances, the timber stringers are supported by round timber posts seated on the solid bottom of the cut. Mining, timbering, drilling, and blasting operations are repeated until all the ore in the cut has been removed. At this time another log mat is laid and the opening is filled.

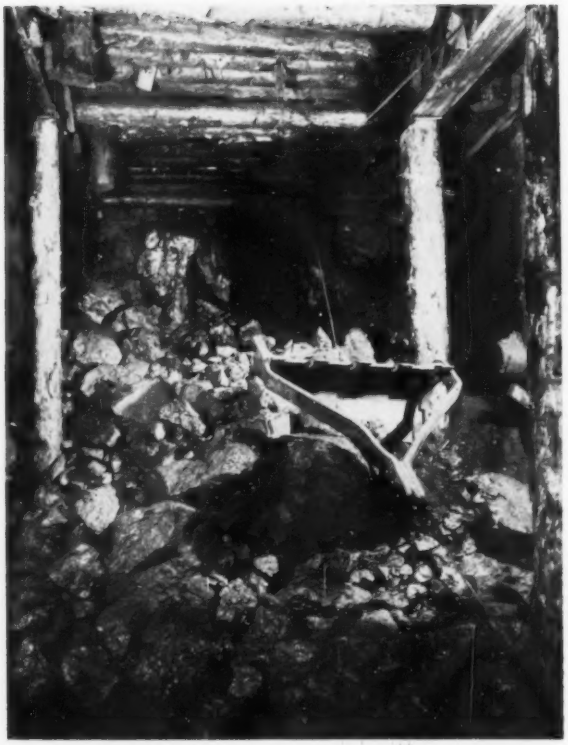
The new method has shown a marked improvement over square-set efficiency. Undercut-and-fill has also proved effective in mining broken areas which would have been wellnigh impossible to mine by square-setting. At the same time it has eliminated the work of booming out ahead of square sets and building timber cribs for overhead cover.

A great deal of study and research was involved in the development of the new method. One of the prime considerations, for example, was setting up a timbering system that would retain the fill mass and provide adequate support, involve only simple repetitive timbering methods, reduce timber consumption over square-set, and use low-cost round logs rather than the framed and dimensioned timber required for square-set. Finally the engineers hit upon the idea of fabricating strong continuous laminated plank stringers on the spot, and laying the mat of logs on top of them. With this arrangement, the only timbering required during the mining operation in the next cut below is the installation of posts under the stringers as the mining face advances.

Tight Sand Fill Essential

Another key requirement to the success of the new method was that fill be placed tight to the bottom of the mat. Due to the angle of repose of water-borne sand fill (tailing), it was realized that tight filling under a horizontal mat would not be pos-

AIRLEGS are used to drill the rounds to advance cut across stope. No standard round is used because of the variable nature of the shattered ground. Great care is used to place and align lifter holes to grade so that the bottom breaks cleanly. This avoids any reblasting and popping the bottom to set stringers on line and grade and ensures a relatively smooth bottom for efficient slushing. Round is drilled, loaded, and shot to blast against log mat; not to damage stringers.



TOOTHED SCRAPERS, 42 inches wide, pulled by 15 horsepower double drum air hoists are used to remove broken ore. Broken ore is pulled into footwall transfer raises. The toothed scraper was developed to dig into the steeply banked muck pile full of boulders against the face and to pull load over the rough bottom. Note the teeth at top of scraper. Teeth are on a reversible back plate which is turned 180° when one set of teeth is worn out. Tail sheave is hooked firmly into log mat.

sible. Observations were then carried out to determine the slope at which sand is deposited in free flow by introducing sand at one end of a working place and decanting drainage water at the opposite end. It was found that the average gradient was 4.0 percent.

An undercut-and-fill pillar was then mined with this slope to check this gradient. Observation towers were built up to the log mat, after which the cut, including the observation towers, was filled. Fill was introduced at the upper end of the slice with a decant point at the lower end. After the cut below was completed the sand was removed from the towers and an inspection made of the fill. It was found that the fill had packed tightly under the sloping mat, and another problem had been overcome.

Design of a special toothed scraper for scraping on the rough, raw bottom of the cut from a muckpile steeply banked against the face was another important development. It was found that taking extra care in drilling lifter holes to line and grade avoided the necessity of reblasting and also assumed a relatively smooth bottom for scraping. Study of blasting technique for the new method showed that a round should be sequenced to blast upwards against the log mat, starting at the center of the cut, to avoid damaging the laminated stringers.

In a pillar stope the first cut is mined 10 feet high and is timbered with standard 5.5 foot square sets. Mining is started at the chute end and advanved across the ore in a series of 6-foot rounds. This is ideal length because it leaves only one unsupported joint in the stringer unsupported after each blast. The stringers are posted at the joint closest to the face so there is never more than 8-feet of unsupported stringer. Just prior to filling the steel stringer plates are removed for reuse.

One advantage of this method is that the heighth of the cut, and the width, too, can be changed to fit different ground. Either of these can be changed while making a cut, of course. The higher the cut the larger the post normally required. This might be a limiting factor at some mines. At Frood it has been found that a safe working face 10 feet high can be mined.

Sand seals are installed at chute and manway before filling which requires about one shift with four men working.

The steel plates, see picture of their installation, strengthen the joints and provide a cup to receive and hold the top ends of the posts when mining underneath the stringers. This simplifies timbering as no braces are needed between posts. A wooden saddle block, see picture, is installed to extend above and between the two top bolts and between the plates at each joint before the timber mat is laid. This prevents the logs from transferring weight to plate and makes it easier to salvage plates for reuse.

Acknowledgement is made with thanks to the International Nickel Company for permission to describe this new stoping method and for furnishing a description of the method, photographs, and the diagram. END

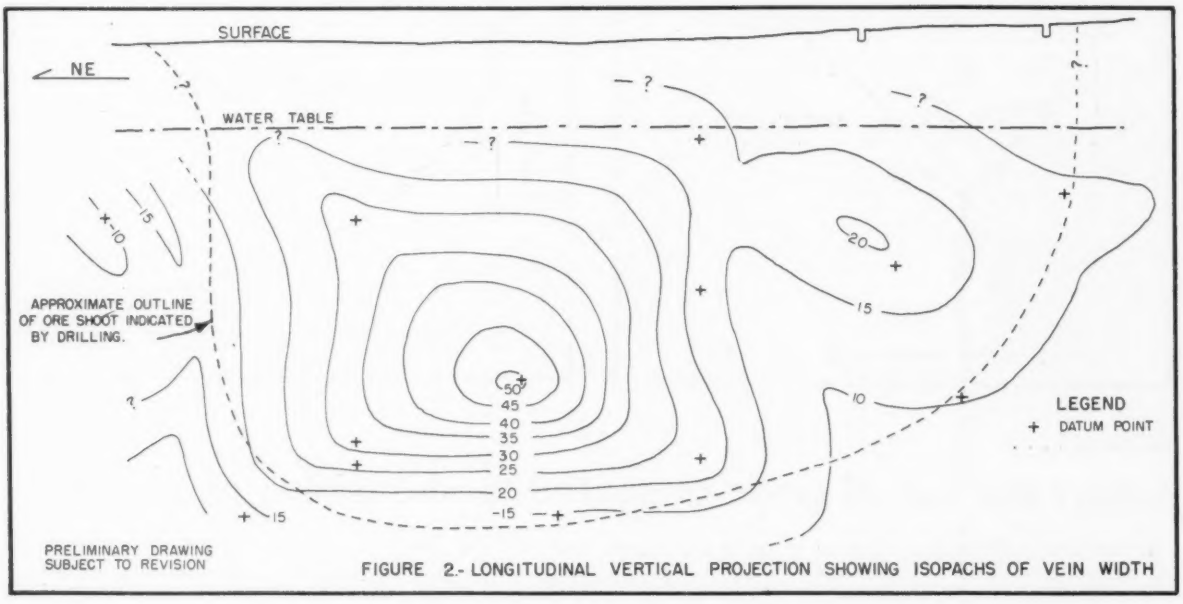


FIGURE 2.- LONGITUDINAL VERTICAL PROJECTION SHOWING ISOPACHS OF VEIN WIDTH

Computer Calculates Best Method to Develop High-Angle Escalante Vein

by **Richard F. Hewlett**
and **John N. Faick**

Electronic computers and supplementary equipment for the solution of mining problems are a recent innovation; consequently, descriptions of practical applications are relatively scarce. The deficiency of case histories warrants discussion of methods succeesfully used by the writers to solve problems pertaining to exploration and development of a small mine. In this computer analysis drill-hole data were programmed and processed by the senior author using facilities of the Numerical Analysis Laboratory at the University of Arizona.

This study concerns the Escalante mine, which at various times was known locally as the Holt or Enterprise mine, and which is located about seven miles north of Enterprise, Iron County, Utah. To bring this undeveloped property into production, American Exploration & Mining Company, of San Francisco, California, is participating with the property owners, Armet Company and Chief Consolidated Mining Company, of Salt Lake City, Utah.

Mr. S. S. Arentz, president of Armet Company, is managing the Escalante venture for the participating companies. Development of the mine is contingent upon successful dewatering of the vein zone, which is being done with a high-capacity turbine pump installed in a large hole drilled to penetrate the vein at a depth of about 600 feet.

The Escalante ore body is contained in a high-angle, silver-bearing quartz vein originally described by B. S. Butler[1] in 1920. It is situated in an area of low hills along the southwestern side of the Escalante Valley of which the geology and ground water resources were described in 1950 in a regional report by Fix and others[2].

The area where the Escalante vein crops out is underlain principally by rhyolite and latite. Considerable tuff and water-laid volcanic sediments were revealed by diamond drilling. Owing to silicification near the vein, the rocks are hard and resistant to erosion and form a low ridge along which most of the vein is prominently exposed. The vein strikes about N. 25° to 30° E. and dips about 60° to 70° northwest. It ranges from about five to 10 feet wide at the outcrop, but subsurface isopachs (Figure No. 2) derived from diamond drill hole penetrations indicate maximum widths as great as 50 feet. The vein walls are smooth and well defined where exposed in shallow workings.

The ore is banded or crustiform, porous, and vuggy. In addition to quartz, the vein contains calcium carbonate, fluorite, adularia, silver and minor base metals. Small amounts of green and yellow crystals and incrustrations, which are found in most penetrations of the vein, were identified as pyromorphite, descloizite, and nickel and copper arsenates.[1] Identification of the silver-bearing minerals has not been completed; however, embolite and native silver have been reported. Drill holes, like those shown in the section of Figure No. 3, explored the vein to a depth of about 650 feet, to which depth the ore minerals are intensely altered with most of the metals occurring in combinations resulting from supergene action. Although silver occurs throughout the vein, there is a great range from low to high values and distribution is erratic. Present information based on incomplete data suggests the richest ore extends from depths of 150 to 500 feet and, at least to a minor extent, seems to be related to the erosion surface and water table.

continued on page 32

Mr. Hewlett is a computer consultant with headquarters in Tucson, Arizona. Dr. Faick is a geologist for American Exploration and Mining Company with headquarters in Tucson.

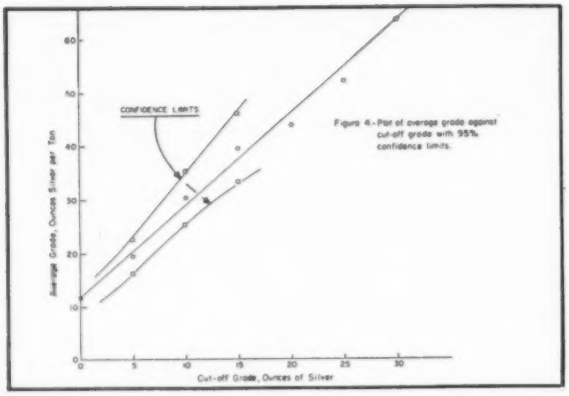


Figure 4.-Plot of average grade against cut-off grade with 95% confidence limits.

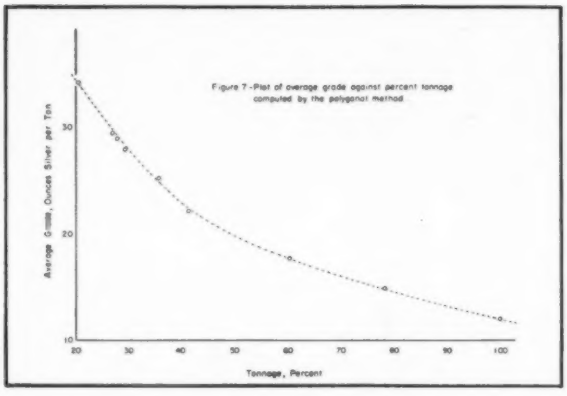


Figure 7.-Plot of average grade against percent tonnage computed by the polygonal method.

ESCALANTE . . .

Assays and cut-off grade computed to plot mining grade graph

Drill-hole samples of the vein were taken on one-foot intervals involving a total of 487 assays. The computer was programmed to determine the cumulative statistical average grade and standard deviation for all assays and for cut-off grades in increments of five ounces of silver per ton. The calculated results are plotted in Figure No. 4. Computed standard deviations for the various cut-off grades were used to calculate the 95 percent confidence interval determined to be the degree of reliability of the estimates of respective average grades (Figure No. 4). Significance of the confidence interval is that the estimate of the mean will fall within the 95 percent confidence interval with one chance in 20 of the mean falling outside the interval.

A curve such as that developed for Figure No. 4 provides a simple device by which an operator can readily plan his production schedule. For example, the average grade of ore when using a cut-off grade of 10 ounces of silver per ton is estimated to be 30.2 ounces of silver per ton, and falls within the interval from 25.5 to 35.5 ounces of silver per ton with a 0.95 probability as indicated by the above confidence interval. This graph is useful for planning of extraction of the economically minable portion of the vein indicated by drilling; and as more assay data become available, similar graphs can be constructed for each stope.

Drill hole data basis for computations

Data used in machine processing of problems pertaining to the Escalante venture were obtained entirely from drill holes. However, similar techniques may be used effectively where data are available from drift, raise, and stope samples. For example, samples from mine workings in vein deposits were used successfully by Koch and Link[3] in a study of the Frisco and Fresnillo mines in Mexico. Other applications of computers to mining problems were recently reviewed in MINING WORLD by Hewlett.[4]

The high speed and relatively low costs of computer operation justify their use in exploration and development problems. The most time consuming and highest cost items are setting up the program, data reduction, and coding, i.e., the process of transferring data to punch cards, magnetic tape, or similar recording devices acceptable to machines. After reduction is completed the data can be processed quickly to solve many different problems.

Reserves and grade of ore in the Escalante mine previously had been calculated in the usual manner from drill-hole data, sections, and contours of metal values and vein widths. Computer processing was used to confirm previous results and to make other interpretations that were impractical by ordinary methods because of the large number of computations required. Use of a computer made it possible to obtain much more information from the drill-hole data at a lower cost than was otherwise possible. Reserve tonnage and average grade were computed for various cut-off grades by statistical, polygonal, and rectangular methods. Graphs from a series of points obtained from computer calculating were prepared to show grade and reserves for various vein widths and cut-off grades. Rectangles constructed over the polygons were further subdivided into small squares, or blocks, for use in determining optimum location of the levels, raises, and hoisting shaft.

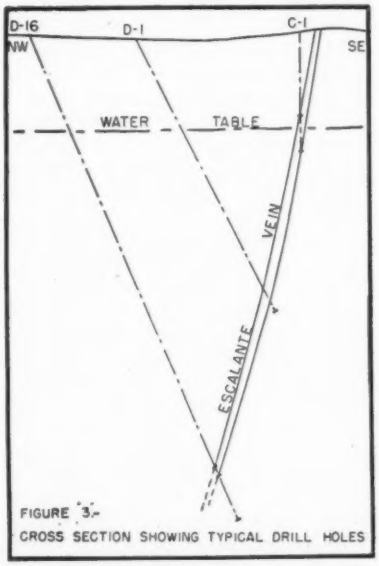


FIGURE 3.-
CROSS SECTION SHOWING TYPICAL DRILL HOLES

For estimating purposes calculations were made only for the ore shoot indicated by exploration drilling as shown in Figure Nos. 2, 3, 5, and 8. It corresponds approximately to that part of the vein containing ore more than five feet wide. To simplify computations they were made in the vertical projection rather than the plane of the vein.

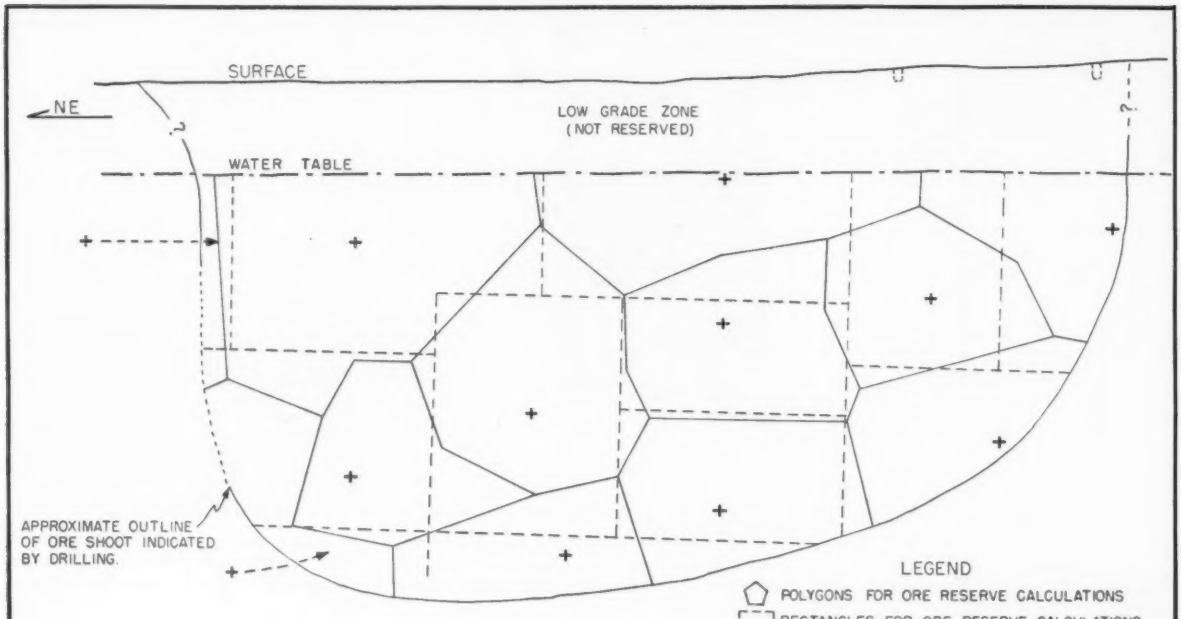


FIGURE 5.-LONGITUDINAL VERTICAL PROJECTION OF PART OF ESCALANTE VEIN SHOWING POLYGONS AND RECTANGLES

Ore reserves by polygons checks reserves using rectangles

Polygons (Figure No. 5) were constructed to define the area of influence of each drill hole and the ore grade for each polygon was calculated from numerous assay intervals from each drill hole intercept of the vein. All computations were reduced to the true width of the inclined ore zone by the computer or desk calculator. Average ore grade computed for the polygons for various average vein widths is shown graphically in Figure No. 6.

Having defined the area of influence for each drill hole and the assay value of each, the remaining variable is the ore reserve which must be expressed in terms of tonnage and grade. Reserves necessarily are a function of vein length, width, and depth recoverable by the proposed mining method. These factors must be considered when making the computations, such as discussed by Lacy[5] for underground ore reserve estimation.

The Escalante vein probably will be mined by shrinkage stoping. Reserve tonnages were calculated from the area of the polygons measured with a planimeter, applicable vein width, and estimated tonnage factor of the ore. These reserves are plotted as percent of total reserves against the corresponding average grades (Figure No. 7).

Inspection of Figure Nos. 4, 6, and 7, indicates some practical applications of the computer results. Figure No. 4 shows that if ore is mined to a cut-off grade of 13 ounces of silver per ton then the average grade would be 32 ounces. For ore having this average grade the minable vein width would be five feet as shown in Figure No. 6. Applying the 32 ounce average grade to Figure No. 7 we find that it represents 23.3 percent of the total ore reserves within the indicated ore shoot. This is the maximum average grade and minimum tonnage of ore expected from the indicated ore shoot. Similarly, mining the entire vein, that is, 100 percent of the vein, in the indicated ore shoot area including barren material or zero cut-off grade, would yield an ore averaging 12 ounces of silver per ton from a vein averaging 21.5 feet wide. The optimum yield or maximum profit yield lies between these two extremes and will be determined to a large extent by direct operating costs.

In veins like the Escalante that have a wide range of values, the grade of the estimated minable reserves must also take into consideration the distribution of value, cut-off grade, possible selectivity in mining, and desired grade of mill heads.

Rectangles were constructed over the polygons (Figure No. 5) so that the drill-hole areas of influence would be geometrically uniform. This construction provides an opportunity to check ore reserve computations made from both polygons and rectangles. Computations are nearly similar for both methods. Comparison of the two methods indicates the tonnage increase from polygons to rectangles was 2.19 percent with a grade decrease of 2.27 percent. In this study construction of rectangles was advantageous because it simplified the use of drill-hole data for simulating mine development and production scheduling.

continued on page 34

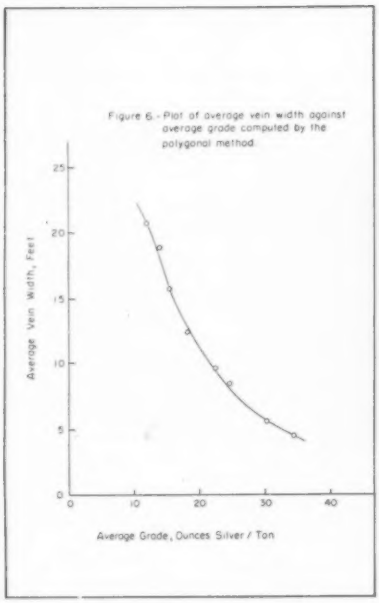


Figure 6.- Plot of average vein width against average grade computed by the polygonal method.

DEEP WELL TURBINE pump discharges 3,500 gallons per minute from drill hole which taps fissure at 500 foot depth. Electric power was brought to the mine site to drive the 440-horsepower Fairbanks-Morse pump. DeWatering of vein precedes sinking.

ESCALANTE . . .

Simulated mine development expressed by mathematical model

A mine development program was simulated by constructing three mathematical models of the proposed Escalante mine. A mathematical model of the vein differs from a three dimensional model in that mathematical equations instead of scale diagrams are used to express the geometric details and other numerous factors in the mine development program. Use of mathematical models to describe the vein makes possible the rapid solution of numerous problems by the computer. Mathematical models constructed for the mine were solved by linear programming, a mathematical technique that permits solution of a set of equations having more variables than equations. Solution by linear programming permits a predetermined objective, such as production rate or profitability to be optimized.

The main purpose of this study was to determine optimum locations of development headings for maximum operating efficiency at a minimum cost. To solve the simulated mine development problems, the rectangles shown in Figure No. 5 were divided into squares, the smallest being 50 feet on a side. These represent blocks of which the third dimension corresponded to the calculated width of the vein. Tonnage and grade for each block were determined from the areas of influence of the drill holes and the calculated vein width. Factors considered in the mathematical models were as follows:

1. Location, development rate, and costs of the shaft, levels, and raises.
2. Ore distribution.
   A. Reserves and grade per block.
   B. Location of blocks with respect to stopes.
3. Tome and rate of production in ounces of silver.

Equations (mathematical models) relating these numerous variables are expressed basically as:

1. PRODUCTION REQUIREMENT PER MINING PERIOD:

$$\left(\sum_{i=1}^{N}\right) T_i$$

2. GRADE REQUIREMENT (X) PER MINING PERIOD:

$$\left(\sum_{i=1}^{N}\right) (T \cdot G)_i \geq X \left(\sum_{i=1}^{N}\right) T_i$$

3. COSTS FOR ANY PERIOD:

$$\left(\sum_{i=1}^{N}\right) [\text{DEVELOPMENT AND DEVELOPMENT COSTS}_i \text{ (PER BLOCK)}]\, T_i$$

—TO BE A MINIMUM WHERE:

N = TOTAL NUMBER OF BLOCKS.
T = TONNAGE PER BLOCK.
G = GRADE (OUNCES AG PER TON) PER BLOCK.
i = BLOCK (NUMBER).

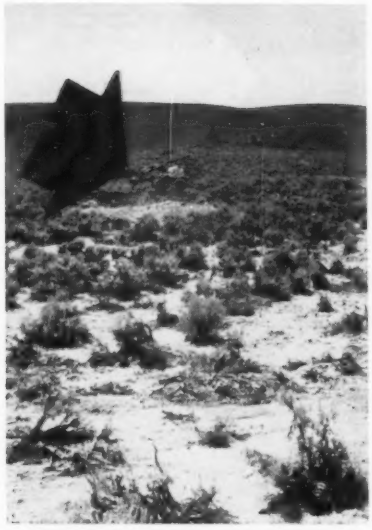
Use of these general equations determined the optimum spacings for the raises, levels, and hoisting shaft by a comparison of costs for fulfilling the production requirements. Three separate mathematical models were used to simplify the problem and to keep the size of the number of variables and equations (matrix) to such a magnitude that the computer storage capacity is not exceeded.

Ground conditions at the Escalante vein permit development workings to be spaced at a considerable distance apart. Geometry of the vein, ore distribution, and development costs were also considered in the first mathematical model, the solution of which indicated a raise spacing of 300 feet to be desirable. By working in the plane of the vein north and south of these raises, uniform stopes having a strike length of about 150 feet were established.

The second mathematical model was constructed to determine the optimum level spacing. Because ground conditions will not be the same throughout the mine, it was thought advisable to determine the optimum spacing of the levels for a range of development raise spacings. Raise intervals from 200 to 325 feet were considered. Other factors in the mathematical model were:

1. Development rate of the shaft and drifts.
2. Development and estimated production costs.
3. Production requirements expressed in tonnage and grade.
4. Ore distribution.

Analysis of the solution to the second mathematical model indicated that a level spacing of about 150 feet is optimum. Level intervals of about 100 feet would incur high development costs, whereas intervals as great as 200 feet would result in higher production costs because of the lim-



FOOTWALL OUTCROP is indicated by arrow. Vein dips to right. The 200-foot-deep prospect shaft shows in distance.

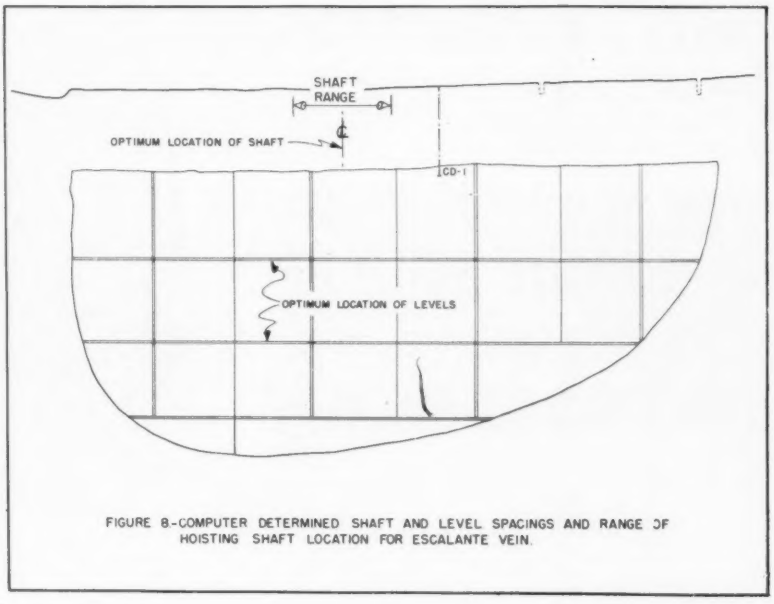


FIGURE 8-COMPUTER DETERMINED SHAFT AND LEVEL SPACINGS AND RANGE OF HOISTING SHAFT LOCATION FOR ESCALANTE VEIN.

ited number of working places available when operating at maximum production rates. If stopes are 150 feet long and 150 feet high, as determined by computer analysis, a degree of uniformity is established which facilitates production scheduling and grade control.

A third mathematical model was constructed to determine the optimum location of the hoisting shaft. Considered in the third model were:

1. Raise spacing of from 200 to 325 feet.
2. Level spacing of 150 feet.
3. Development rate and costs of raises, levels, and hoisting shaft.
4. Production requirements.

The main restrictions placed against the solution of the model are that the highest grade of ore be mined first as to provide the earliest possible return of capital investment commensurate with sound operating policy and that the overall costs be kept at a minimum. Therefore, the first raises and levels driven will prepare some of the highest grade and most accessible ore for mining during the early stages of the operation. See Figure No. 8.

An interesting aspect of this study is that the raise and level interval determined by computer processing of the drill-hole data corresponds closely to the intervals selected by Sam Arentz, and others, on the basis of sound judgment resulting from many years of training and experience. For practical reasons the shaft was placed a short distance from the indicated optimum location in order to obtain the best topographic conditions for a surface plant.

The writers take this opportunity to thank the management of American Exploration and Mining Company, Chief Consolidated Mining Company, and Armet Company for permission to publish this analysis of exploration and development problems of the Escalante venture. Grateful thanks are tendered Dr. Willard C. Lacy who has shown special interest in the preparation of this paper and kindly reviewed the manuscript.

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5. Lacy, W. C., 1961; Application of computers to underground ore reserves estimation: *Transactions of Short Course on Computers and Computer Applications in the Mineral Industry*, College of Mines, University of Arizona, section J, p. 1–8.

Escalante proves small mines can use computers

Ore reserves and average grade for the Escalante mine were computed by the polygonal and rectangular methods and the grade was also determined statistically. A simulated mine development problem was solved to determine optimum location of hoisting shaft, levels, and raises.

This study of the Escalante mine indicates that the use of data processing equipment is warranted on exploration and development problems of small mines. The use of computers is justified especially on problems requiring a large amount of computations as shown by this study of the Escalante vein, for which several hundred thousand computations were made. Results of these computations are plotted in graphs as in figure Nos. 4, 6, and 7. These graphs provide simple devices by which a mine manager easily can plan to meet his development and production requirements. In problems where accuracy is important the solutions can be checked by solving the problem by different methods or by slight changes in input data. Once programs have been worked out for the solution of specific problems they become available for the solution of other similar problems. Thus, the programs developed for the Escalante venture are available at the College of Mines, University of Arizona, as are many other programs.

Why you should always use **STOODY BUILD-UP** to support a **HARD-FACING OVERLAY**

Worn parts are sometimes rebuilt with mild steel followed with an overlay of hard-facing. This procedure is like trying to support a thin glass plate on a sponge. *Poor compressive strength in the supporting base causes cracking and spalling of the surface alloy.* To insure a proper base use STOODY BUILD-UP... *it does a job mild steel can't approach!*

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No. 2 E-7010 DEPOSIT—Somewhat better than E-6010 but still inferior for the job.

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PRODUCTION EQUIPMENT preview

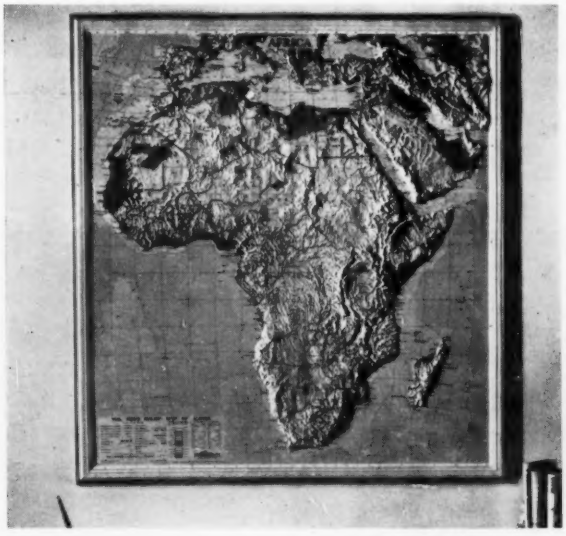
FOR DATA ON ANY ITEM IN THIS SECTION PLEASE USE INQUIRY CARD

Efficient Inexpensive New Turbo Pulverizer

A new, highly efficient grinding machine called the Law Turbo Pulverizer is currently being produced at Hirsch Brothers Machinery Company, El Paso, Texas.

The machine manipulates fast-moving air to cause friable materials to grind themselves into particles of controlled size down to almost infinite fineness. Uniformity of size of ground particles is controlled by back pressure governed by a damper. The harder the material the faster it is pulverized. According to the manufacturers, it operates at one fifth the cost of conventional industrial pulverizing equipment.

The Law Turbo Pulverizer will pulverize any friable material, and with modifications it will separate into threads fibrous materials (such as asbestos) without crushing. Write: **Bishop White & Associates, Dept. MW, 4309 N. 16th Street, Phoenix, Arizona.**



Plastic Raised Relief Map of Africa Available

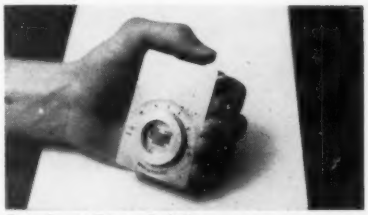
A new map of Africa, the first ever formed in raised relief, has been published by Aero Service Corporation, a world-wide air mapping company.

The 45- by 49-inch map is made of a new plastic so tough you can walk on it, and Mount Kilimanjaro stands up nearly one inch in relief. Of the 47 African nations shown, 21 are new nations established in the past five years. Newest nation is Sierra Leone, which became independent in April of this year. The map is printed in ten colors with a scale of one inch to 126 miles (1:8,000,000), and has nearly 1,500 geographical names mentioned. The company is now preparing a relief map of Asia which will be in production shortly. For information on these plastic relief maps write: **Ted Kenney, Dept. MW, Aero Service Corporation, 210 East Courtland Street, Philadelphia 20, Pennsylvania.**

New Rubber Lining Material

A hardy, new industrial rubber lining material that cold-bonds itself to metal and other surfaces with field-applied cement has been developed by The Goodyear Tire & Rubber Company.

When utilized in countless industrial applications, the natural rubber covering —Jade Green Armabond—will provide complete protection against impinging abrasion and chemical action of most inorganic salts, alkalis, and acids, according to the company. The new material is designed to protect interior surfaces of chutes, mills, cyclone collectors, shot and sand blast machinery, and other equipment. It is also suitable for "recapping" conveyor belts. Through its specially compounded tie-gum backing, it may be cold bonded to a wide variety of surfaces, including metal, fabrics, and other rubber compounds. Write: **Goodyear Tire & Rubber Company, Dept. MW, Akron, Ohio.**



Pocket-Sized Magnetometer

An inexpensive pocket-sized magnetometer has been developed by Arvela of Finland. No auxiliary magnets, batteries, or tripods are required, and its rugged construction makes it ideal for use in remote areas. Readings can be made in 10 seconds to about 100 gammas or 500 gammas on two scales. The range is about 60,000 gammas, and in operation the instrument is hand held. Write: **E. R. Randolph, Dept. MW, Exploration Methods, Inc., P. O. Box 100, Ishpeming, Michigan.**

New Specialized Drilling Tools

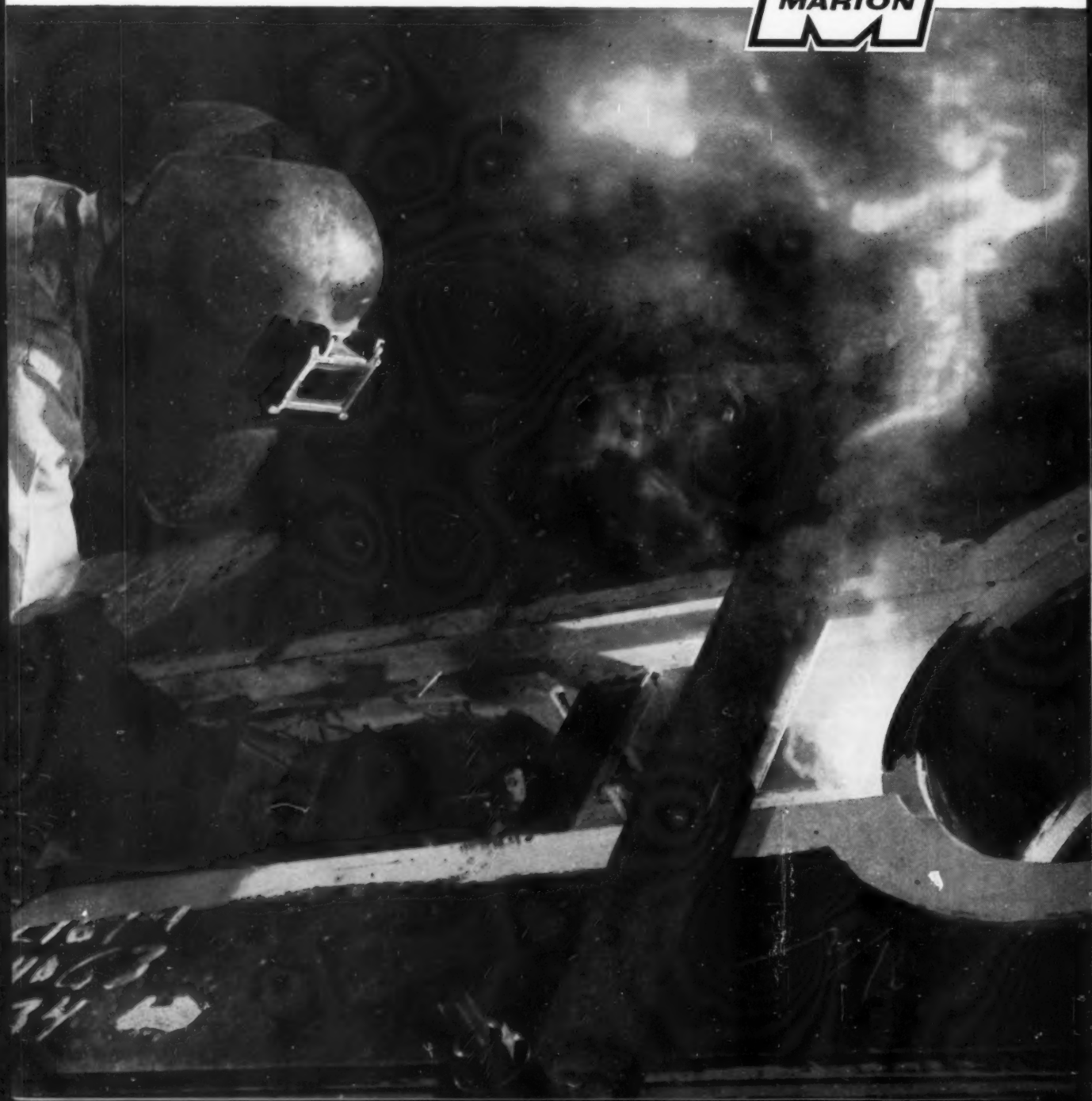
Odgers Drilling, Inc. has recently introduced a new line of hydraulic actuated tools for the drilling industry. This line consists of a hydraulic casing cutter, hydraulic underreamer, and hydraulic casing puller.

The hydraulic casing cutter is capable of cutting casing in any position in the drill hole, and can be withdrawn from the casing after cutting. The hydraulic underreamer is capable of underreaming casing already in the drill hole without having to remove the casing from the hole to ream further. The hydraulic casing puller pulls casing from the bottom instead of pulling from the top as is presently done. The casing puller will not damage stuck casing, and in most instances will free stuck casing for salvage and reuse. For information write: **M. A. Nelson, Odgers Drilling Company, Inc., Dept. MW, Ice Lake Road, Iron River, Michigan.**

THIS IS MARION QUALITY

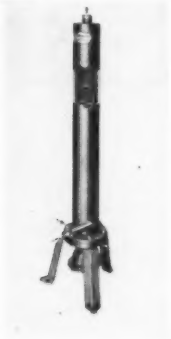
Ever hear of a "hydrogen embrittled" weld? It happens when the welding materials being used do not eliminate a sufficient percent of molecular hydrogen from the weld metal. As the weld cools the trapped hydrogen forms pressure pockets and—crack—the weld's finished. Happily, for you and for us, you'll seldom if ever encounter that on a Marion mining machine. Our secret? Start with a low hydrogen electrode . . . that provides the toughest weld deposit available . . . bake at a certain temperature to reduce moisture (H_2O) from the flux coating. Place in a holding oven until just before use. The result? High strength welds that are often stronger than the surrounding metal. Add to that a team of welding technicians who continually check important welds . . . fully automatic welding equipment and positioners custom made to Marion's rigid specifications . . . and that very tangible "pride in product" attitude that pervades our plant and you have one of the most significant answers as to why Marion excavators produce more for less. Marion Power Shovel Company, Marion, Ohio. A Division of Universal Marion Corporation.

MARION



Small Efficient Aftercooler

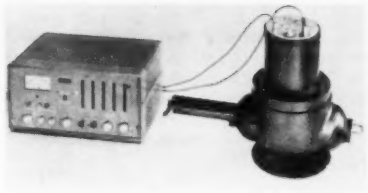
Hot, wet air is no longer a problem for users of small and medium sized compressed air systems because of a new Aftercooler recently introduced by J. A. Murphy & Company. Small, efficient, and easy to install, the Murphy A4VC Aftercooler is low in price, has no moving parts, and requires practically no maintenance.



Built for capacities of 50 to 120 cubic feet of free air per minute, it features a non-corrosive copper coil through which the valve regulated cooling water flows. Coil is attached to the flanged head with flared connections and supported throughout its length by spaced baffle plates which direct the flow of air for utmost contact with the cooling coil. Separated moisture descends by gravity to the Murphy Ball Float Trap below where it is ejected automatically and without loss of air. Write: **Jas. A. Murphy & Company, Inc., Dept. MW, 1421 East High Street, Hamilton, Ohio.**

Wet Sand Flows Like Water

Moist sand runs like water from a small opening in a 10-ton test live bin developed by Vibra Screw Feeders, Inc. The 10-ton bin was constructed in the form of a tall narrow cylinder, having a bottom slope of only 10°, and an outlet of only 3- by 10-inches. A three horsepower drive motor vibrates the bin, which rests on four heavy duty rubber mountings. Notwithstanding the adverse design features, moist sand runs out of the agitated bin like water. Write: **Vibra Screw Feeders, Inc., Dept. MW, 156 Huron Avenue, Clifton, New Jersey.**



New Laboratory Berylometer

A new laboratory berylometer has been announced to provide an extremely accurate measuring device for determining the beryllium content in a given ore sample.

The laboratory Model BEL 100B includes a sensitive five decade scaler, detector head, and a lead castle. It can be used by processors, fabricators, and manufacturers of beryllium metal and alloys to continually check the content and condition of the work they have in process. Write: **Research Chemicals Division, Dept. MW, Nuclear Corporation of America, Burbank, California.**

Precipitation Rectification

Buell Engineering Company, Inc. offers a four-page brochure covering its new silicon-rectifiers conversion unit for electrostatic precipitators. The brochure tells how silicon rectifiers provide at least 25 percent more efficient rectification than outmoded mechanical rectifiers, and explains how conversion unit cost, low installation cost, and virtually no maintenance costs save money for the user. For a copy of this informative brochure write: **L. S. Goldberg, Buell Engineering Company, Inc., Dept. MW, 123 William Street, New York 38, New York.**

Quick Mineral Identification

Good quality microscopes for use in the identification of minerals by the index of refraction method are now available to geologists, mineralogists, miners, mill men, and prospectors.

Three grades and sizes of instruments are furnished in the "Black Hills Polarizing Microscopy Kits." The lowest price kits sell for $65.00, and consists of a medium size, very good quality microscope having both coarse and fine focus adjustment, integral mechanical and rotating stage, polarizer and analyzer, 10X and 20X oculars, and four turret mounted objectives of 5X, 20X, 30X, and 45 powers.

Included in the kits are petrographic slides and cover glasses, index of refraction oils for beryl, pollucite and quartz, a supply of ground and sized minerals of each, and a book of simplified instructions. This book and kit enables anyone to quickly become proficient in the interesting and useful technique of mineral identification. Also available are larger and more expensive kits. For more information write: **Black Hills Ore Research Laboratories, Dept. MW, P. O. Box 3132, Rapid City, South Dakota.**

WORM GEAR MOTORS: A new brochure containing technical data, feature illustrations and descriptions of its new line of advance-design right-angle worm gear motors, is now available from **U. S. Electrical Motors Inc., Dept. MW, P. O. Box 2058, Terminal Annex, Los Angeles 54, California.**

MICRO SWITCH line of precision switches for mining, industrial and commercial applications are detailed in a new 20-page catalog now available from the **Micro Switch division of Minneapolis-Honeywell, Dept. MW, Freeport, Illinois.**

FOR EFFICIENT SCREENING the Leahy screen of Deister Concentrator Company, made in 12 sizes, is capable of handling any screening chore in the fine mesh range. Write: **Deister Concentrator Co., Inc., Dept. MW, 925 Glasgow Avenue, Fort Wayne, Indiana.**

"MATERIAL for Advanced Technology" is a handy data-packed, 8-page, two-color roundup on 12 new products from **The Carborundum Company's Research and Development Division, Dept. MW, P. O. Box 337, Niagara Falls, New York.**

GATE VALVE: Bulletin 301 describes and illustrates DeZurik Corporation's new fab-cast bonnetless knife gate valve used on fibrous, viscous, and slurry lines, crystalline and caking sludges, abrasives and corrosive materials. Write: **Al Kremers, DeZurik Corporation, Dept. MW, Sartell, Minnesota.**

SUPER VIBRATORS made by the Martin Engineering Company are detailed in a new four-page folder that describes air, electric, gasoline, and hydraulic powered vibrators for use on hopper cars, bunkers, chutes, etc. Write: **Martin Engineering Company, Dept. MW, Neponset, Illinois.**

DRAGLINE BUCKETS in the four to seven cubic yard range are described in a new two-color, four-page bulletin just released by Page Engineering Company. Illustrations and details are given on both general purpose and heavy duty Page Automatics. Write: **T. A. Lyons, Page Engineering Company, Dept. MW, Clearing Post Office, Chicago 38, Illinois.**

CLUTCHES AND BRAKES for all types of equipment used by the mining industry are covered in a 31-page catalog. Write: **Wichita Clutch Company, Inc., Dept. MW, Wichita Falls, Texas.**

ROTA-SCREW COMPRESSOR is a new development in portable air compressors just announced by Gardner-Denver Company. Details and description of three models available are given in an illustrated brochure. Write: **Gardner-Denver Company, Dept. MW, Quincy Illinois.**

FRONT END LOADERS are detailed in a new booklet covering wheel-type and track-type Traxcavators. Write: **Advertising Division, Dept. MW, Caterpillar Tractor Company, Peoria, Illinois.**

NEW DOWN-THE-WHOLE BIT by Sandvik Coromant is available from 4¾ to 9 inches in diameter. Information on these tungsten carbide bits can be obtained from **Atlas Copco, Inc., Dept. MW (MN 61-2), 610 Industrial Avenue, Paramus, New Jersey.**

DUMP CARS that feature fast dump action with fully enclosed door control mechanism located at ends of cars are available in any size up to 60 cubic yards and 100 tons capacity. Write: **Baldwin-Lima-Hamilton, Industrial Equipment Division, Dept. MW, Philadelphia 42, Pennsylvania.**

RUBBER COMPOUND with high abrasion resistance can be cold bonded to conveyor belts, transfer chutes and feeders, heavy duty screens, and pumps. For information write: **Mr. B. D. Crawford, Linatex Corporation of America, Dept. MW, Vernon Avenue, Rockville, Connecticut.**

NEW OFF-HIGHWAY truck in 45-ton class features a newly designed heavy duty bogie said to provide greater ruggedness and tractive ability while adding to tire life. Write: **Mack Trucks Inc., Dept. MW, Empire State Building, New York 1, New York.**

BALL AND ROD MILL specification manual containing complete information on grinding mills is now available. Case history information, drawings, engineering tables, and valuable technical data are included. Write: **Denver Equipment Company, Dept. MW, 1400 17th Street, Denver 17, Colorado.**

METAL BUILDINGS: A new illustrated brochure describing the SF Series pre-engineered metal buildings for commercial and industrial applications has just been published. Write: **The Parkersburg Rig & Reel Company, Dept. MW, Parkersburg, West Virginia.**

HOSE FITTINGS, industrial pressure clamps, and other allied products are detailed in a new 24-page illustrated catalog, Write: **Band-It Company, Dept. MW, 4779 Dahlia Street, Denver 16, Colorado.**

BLAST HOLE BITS are the subject of a 12-page catalog covering the uses of Super-Aire bits in the mining and quarrying industries. Write: **Dresser Industries, Security Engineering Division, Dept. MW, P. O. Box 13647, Dallas, Texas.**

VALVE importance and operation in modern reciprocating compressors are described in a new 44-page booklet, "Questions and Answers About Valving." Write: **John Uhler, Ingersoll-Rand Co., Dept. MW, Phillipsburg, New Jersey.**

NEWSMAKERS in mining world

Stanley H. Cohlmeyer has been named general superintendent of the United States Steel Corporation's Columbia-Geneva Steel Division's Atlantic City taconite mine, near Lander, Wyoming. In this new post, Mr. Cohlmeyer will direct all operations of the new iron mining and beneficiation facilities scheduled for completion late next year. Well known in Wyoming, he will continue serving as project manager for Columbia-Geneva Steel during the construction phase of the project.

John E. Bailey has been appointed a New Mexico deputy state inspector of mines, replacing **E. Kelly Mora,** who has resigned. Mr. Bailey had been safety engineer for Kermac Nuclear Fuels Corporation for the past year. He will work out of the state mine inpector's office in Albuquerque.

George C. Branner has opened a mining consulting office at 150 Scenic Avenue, Piedmont, California. Mr. Branner enters private business after a 30-year career with federal and state agencies including the United States Bureau of Mines.

Charles Will Wright, son of one of the founders of the Michigan College of Mines and Technology, attended the school's 75th anniversary celebration in August at Houghton, Michigan. He was graduated from the Michigan College in 1902 and was later given an honorary degree of Doctor of Engineering.

Kenneth Olson, superintendent of the Humboldt mine of Cleveland-Cliffs Iron Company, has been transferred to the Eagle Mills pellet plant and **Walter Rembold,** superintendent of the Eagle Mills plant, has been transferred to the Humboldt mine as superintendent.

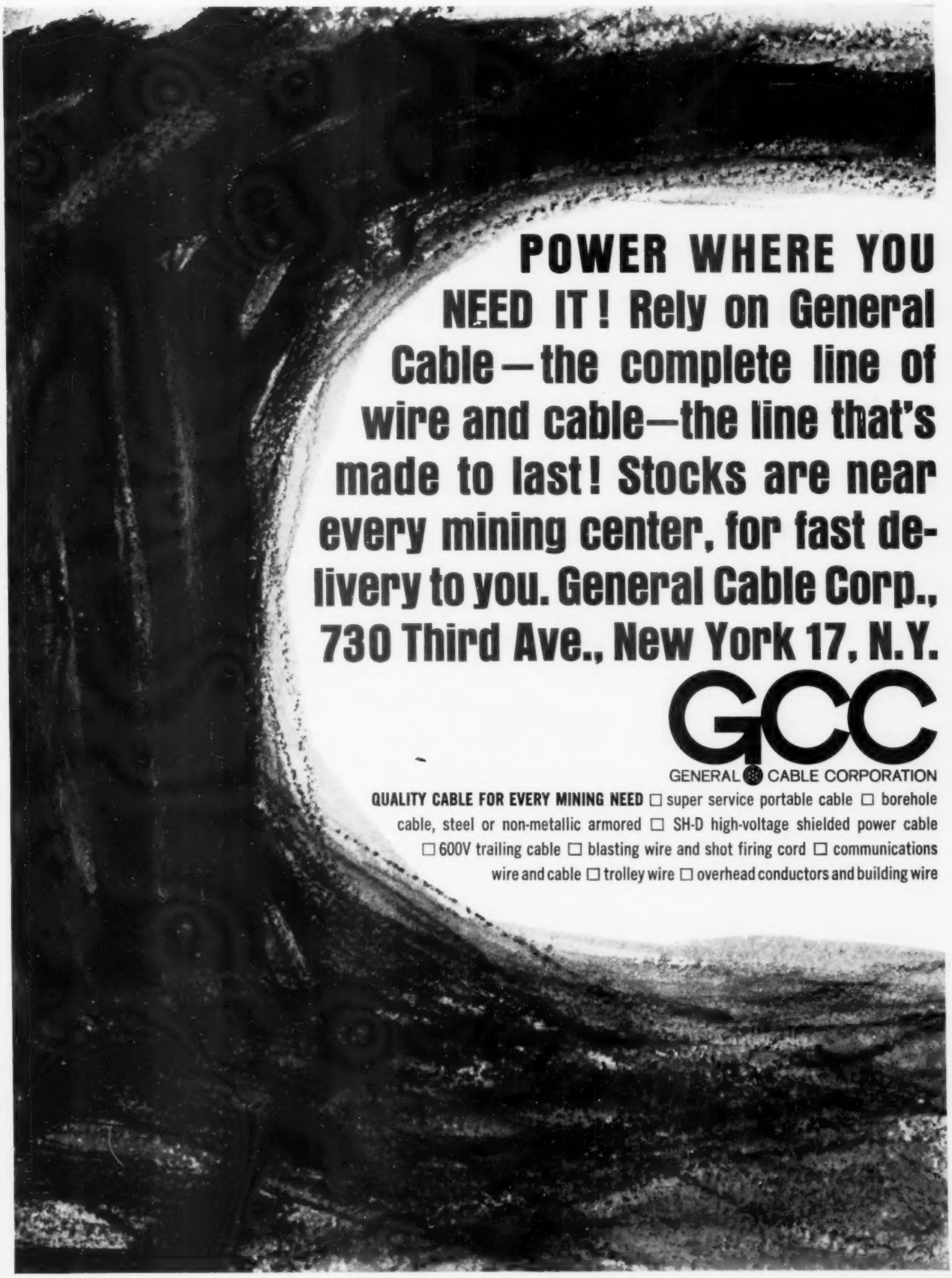
Dr. Lauren A. Wright, chief of the Los Angeles, California, branch office of the California State Division of Mines, has resigned to become head of the geology department at Pennsylvania State University. **Bennie W. Troxel,** assistant, will become acting head of the office pending a state civil service promotional examination.

Robert W. Williams has assumed duties as personnel director of Anaconda Copper Company's Grants, New Mexico operations. Mr. Williams, who succeeds **Frank A. Welch, Jr.,** had been an assistant in the company's western operations personnel office in Butte, Montana. Mr. Welch has been promoted to a similar position with Anaconda's Raritan copper operation at Perth Amboy, New Jersey.

John Edgar, associated with Sunshine Mining Company, Spokane, Washington, for the past 26 years, has been elected vice president. He had been general manager of the mining division for the past several years, and before that was chief engineer, superintendent, and general manager of the Kellogg, Idaho, operations. He has been active in the affairs of the Idaho Mining Association, Northwest Mining Association, and is a member of the AIME and natural resources committee of the United States Chamber of Commerce.

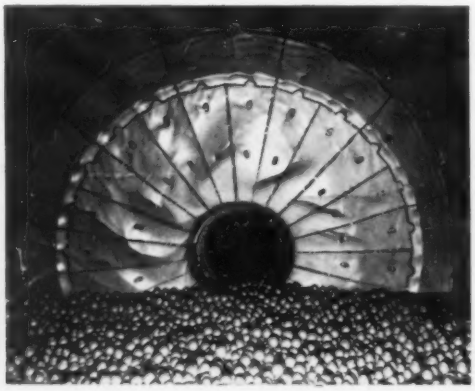
A. A. Friedman has taken over as resident manager for the Old Dick mine of Cyprus Mines Corporation at Bagdad, Arizona, succeeding **Curtis Sundeen,** who has resigned. Mr. Friedman had been assistant resident manager of the Pima Mining Company at Tucson, Arizona.

D. L. Hetland, geologist in charge of the Atomic Energy Commission's northwest district office at Spokane, Washington since 1955, has been transferred to Utah as chief of the AEC's Monticello office. He has been succeeded in Spokane by **David P. King,** formerly of the commission's Casper, Wyoming office.


POWER WHERE YOU NEED IT! Rely on General Cable—the complete line of wire and cable—the line that's made to last! Stocks are near every mining center, for fast delivery to you. General Cable Corp., 730 Third Ave., New York 17, N.Y.
GCC
GENERAL CABLE CORPORATION
QUALITY CABLE FOR EVERY MINING NEED ☐ super service portable cable ☐ borehole cable, steel or non-metallic armored ☐ SH-D high-voltage shielded power cable ☐ 600V trailing cable ☐ blasting wire and shot firing cord ☐ communications wire and cable ☐ trolley wire ☐ overhead conductors and building wire

Amsco dippers last longer loading ore cars. Owners of this mine have converted over 90% of their shovels to Amsco dippers like this 6 cu. yd. model because of their toughness and resistance to abrasion. Excellent Amsco service had a part in the decision, too. This shovel loads about 6,300 tons of ore per 8-hour shift.

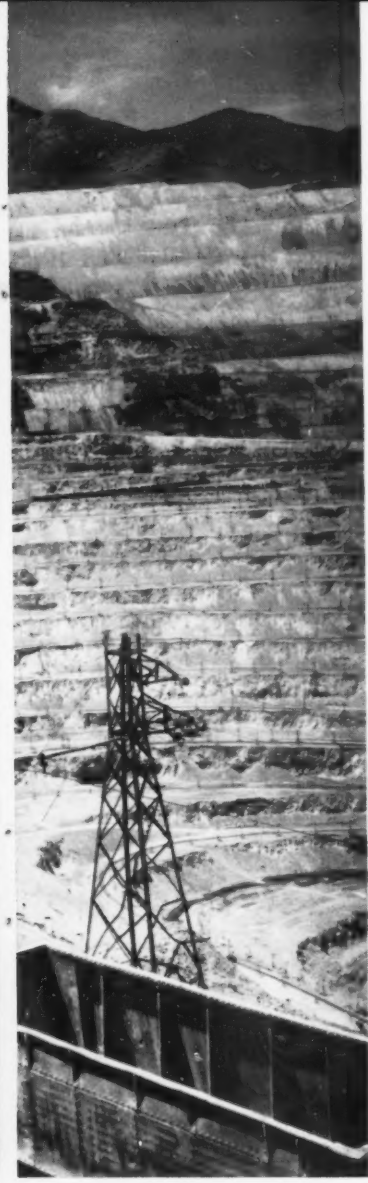
1000 hours of sand harvesting before major servicing. That's the record of this Amsco 6". It pumps 1,200 gallons of 15% sand solution per minute.



Amsco offers the widest available range of liner designs and special alloys for ball and rod mill liners to suit all conditions of impact and abrasion. Each mill is custom engineered for smooth flowing design and long liner life.

Crusher roll life is increased 5 to 10 times with "Pair for Wear" electrodes—Nicro Mang* for manganese steel welding and X-53 for general hardfacing.

*TRADEMARK REGISTERED



AMSCO WEAR PARTS

help you handle more tons per dollar

Impact and abrasion take their toll of wearing parts and cut deep into your profits. Worn dipper teeth, pumps, crusher rolls, dozer end bits and mill liners can cut *tons* off your production.

Amsco alloy castings include manganese steels, chrome-moly steels, multiple alloy engineering steels and high chromium iron—all developed to meet your specific needs whether it be impact, abrasion, or both. Each type is carefully guarded for proper chemical and physical properties and uniform heat treatment.

If wearing parts on machinery increase costs per ton you'd better investigate Amsco alloy wear parts. Your nearby Amsco representative can analyze your particular application and recommend an Amsco alloy product that will produce or move material at the lowest operating cost per ton. If you don't know his name, write and we'll send you his address.

Try this simple test made on this Massachusetts rock job: Two Amsco Simplex 2-part teeth were installed on the outside corners of a shovel dipper. Competitive 2-part teeth were installed between them. Midway through the test the positions of the teeth were changed. Simplex 2-part teeth showed *less than half the wear of competitive teeth.* Tips stay sharp and can be reversed in minutes.

American Brake Shoe Company

They're backed by experience...

Other plants in:
Denver • Los Angeles • New Castle, Delaware
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IN CANADA: Joliette Steel and Manitoba Steel Foundry Divisions
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Welding products distributed in Canada by Canadian Liquid Air Co., Ltd.

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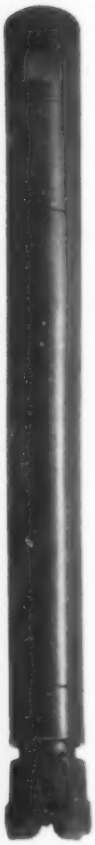

New Series 100 Hammerdril

chip size proves Hammerdril puts more *bite* in your bit because it cleans as it drills

When it comes to chips, think big. Big chips are a sure sign of economical drilling action, the kind that saves air, speeds drilling rate. With the Series 100 Hammerdril® air either drills or cleans. You can start at once with this dependable bottom hole pneumatic impact tool on your present rig and 100 psi compressor. Simply adjust the Hammerdril with the proper positive choke to suit your compressor. Then dig in, using the Mission Hammerbit®. The heavy tungsten-carbide inserts can be dressed in the field.

Write for new bulletin.

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HAMMERDRIL

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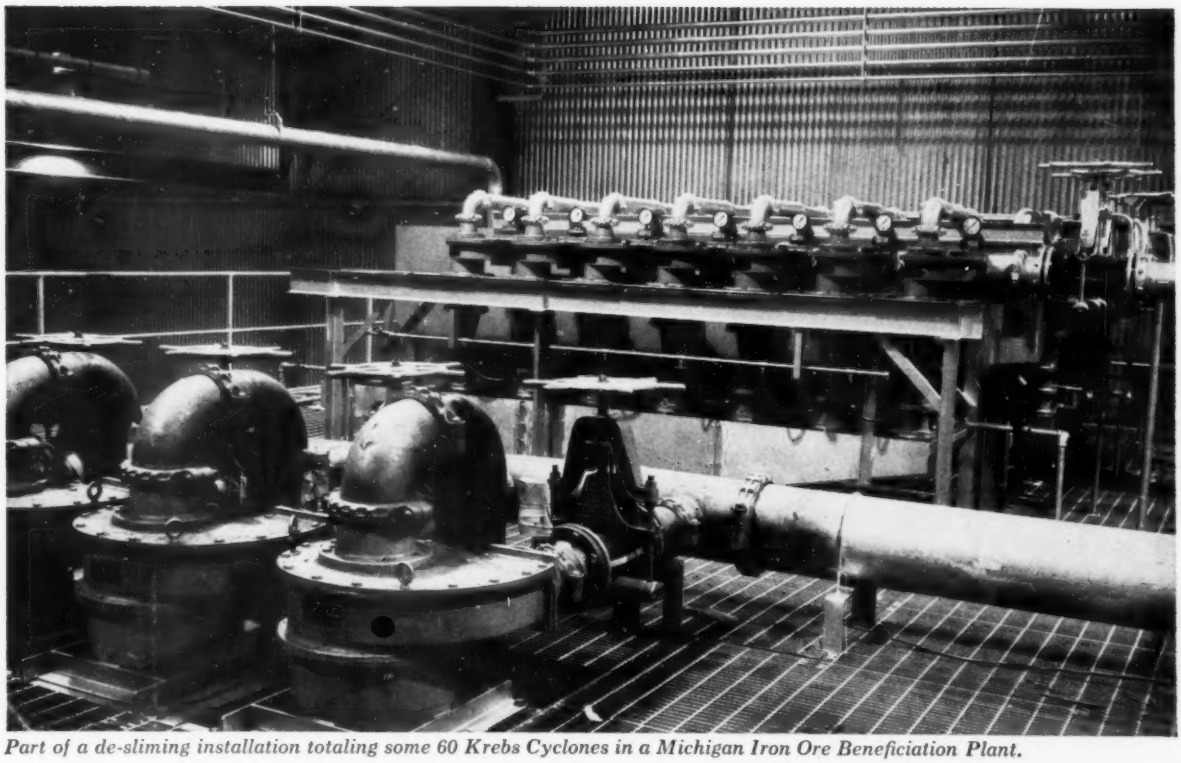


Part of a de-sliming installation totaling some 60 Krebs Cyclones in a Michigan Iron Ore Beneficiation Plant.

Why Krebs Cyclones give you Better Classification, yet cost less

Greater capacity per unit size Because the involuted feed entry on a Krebs Cyclone minimizes turbulence and pre-orients particles for efficient classification, a larger vortex finder can be used for a given size cyclone, providing higher capacity and equivalent separation for a given pressure drop. This same design feature can be used advantageously to obtain a finer separation for any equivalent cyclone, orifice combination and pressure drop.

Greater flexibility Because Krebs Cyclones are available with the widest variation in orifice sizes, including adjustable apex valves, they can be tailored more carefully to fit the precise requirements of a given job. As a result, Krebs Cyclones not only match capacity requirements with the highest degree of accuracy, but also provide the optimum in fineness and sharpness of separation.

Greater life expectancy Because Krebs Cyclones utilize specially compounded, extra-high-density liners, they exhibit extremely good abrasion resistance and outlast vulcanized or low-pressure molded liners many times over. Many main body liners in Krebs Cyclones have been in service for more than 5 years, some having handled in excess of 2 million tons per unit.

Because Equipment Engineers Inc. is devoted exclusively to cyclone technology, you get all the advantages of dealing with a specialist when you specify Krebs Cyclones. Your classification problems are studied by a staff of skilled engineers representing an unmatched accumulation of experience in the design and practical application of cyclones in the metallurgical field.

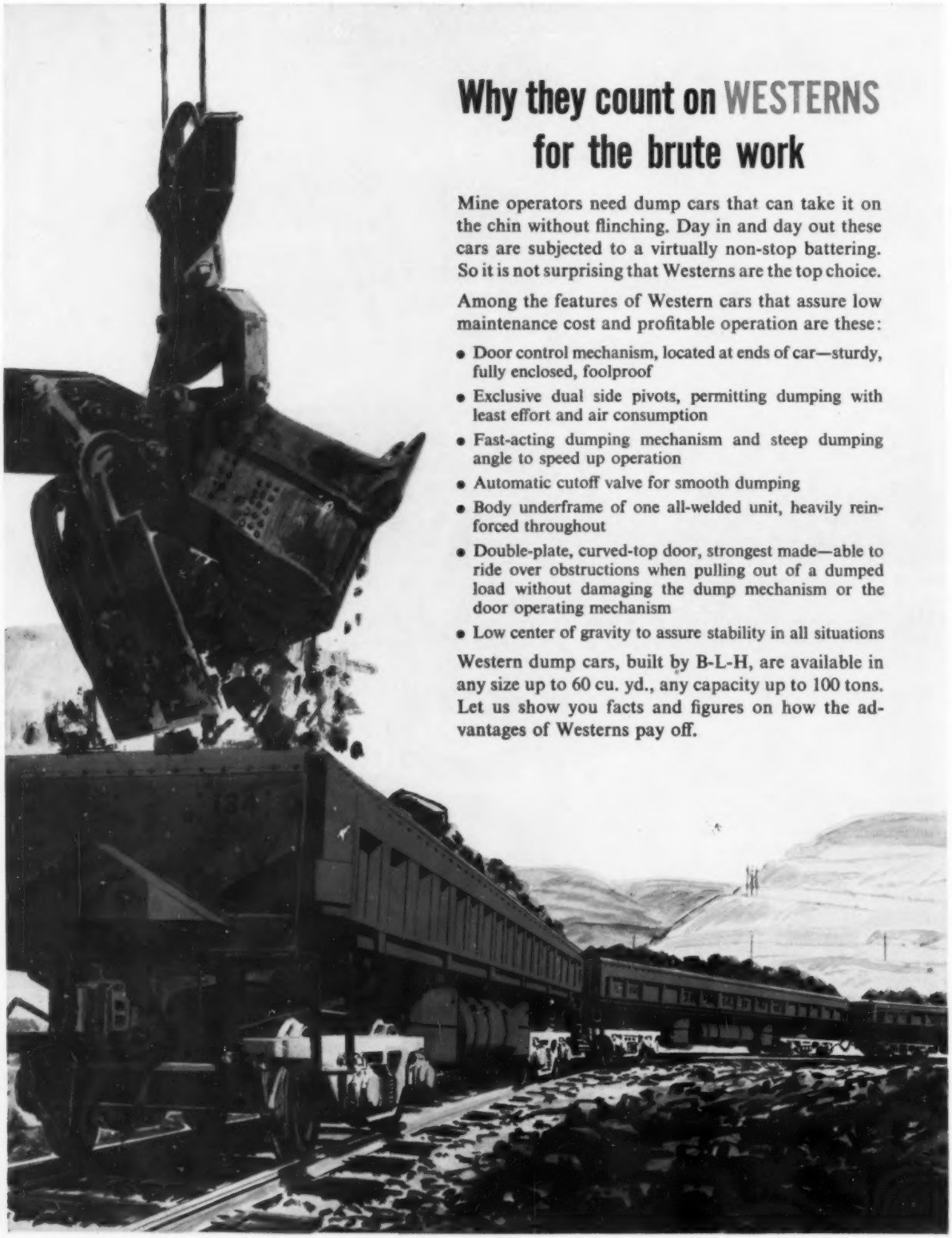
A significant factor in the success of every Krebs Cyclone installation is the careful engineering analysis which precedes it. To evaluate your classification needs, we maintain a pilot plant equipped for full-scale testing. From analysis of test results, Equipment Engineers metallurgists are able to predict over-all plant performance with a high degree of accuracy. Your inquiries are invited.

KREBS

EQUIPMENT ENGINEERS INC.

737 Loma Verde Avenue Palo Alto 3, California

Photo Courtesy of Bechtel Corporation



Why they count on WESTERNS for the brute work

Mine operators need dump cars that can take it on the chin without flinching. Day in and day out these cars are subjected to a virtually non-stop battering. So it is not surprising that Westerns are the top choice.

Among the features of Western cars that assure low maintenance cost and profitable operation are these:

- Door control mechanism, located at ends of car—sturdy, fully enclosed, foolproof
- Exclusive dual side pivots, permitting dumping with least effort and air consumption
- Fast-acting dumping mechanism and steep dumping angle to speed up operation
- Automatic cutoff valve for smooth dumping
- Body underframe of one all-welded unit, heavily reinforced throughout
- Double-plate, curved-top door, strongest made—able to ride over obstructions when pulling out of a dumped load without damaging the dump mechanism or the door operating mechanism
- Low center of gravity to assure stability in all situations

Western dump cars, built by B-L-H, are available in any size up to 60 cu. yd., any capacity up to 100 tons. Let us show you facts and figures on how the advantages of Westerns pay off.

BALDWIN · LIMA · HAMILTON

Industrial Equipment Division · Philadelphia 42, Pa.

PROOF (from Anaconda)

that a Ni-Hard Mill Liner is good to the last ¼ inch

You've heard it said many times..."A Ni-Hard Mill Liner is good to the last ¼-inch!"

Well here's photographic proof; from the Montana mines of The Anaconda Company, where the long life and outstanding performance of Ni-Hard* nickel-chromium-iron alloy liners have saved many thousands of hours of downtime. And done wonders for tonnage too — in both ball mills and rod mills, at the feed end as well as the discharge end.

This "good-to-the-last-¼-inch" performance of Ni-Hard mill liners can do wonders for your tonnage. For if ever there was a service where superior abrasion-resistance coupled with a uniform wear-rate really counts, it's in mill liners. Try a set of Ni-Hard liners in your mills and see for yourself.

Ni-Hard iron's superior abrasion-resistance and uniform wear-rate also count heavily in prolonging the life of feed spouts, pipe elbows, slurry pump liners and impellers, dust-collector cyclones, chute liners and many other parts for ore-processing equipment.

Our detailed, 58-page booklet, "Engineering Properties and Applications of Ni-Hard" suggests many ways to put versatile, long-wearing Ni-Hard to work profitably. Say the word and we'll be glad to send you a copy.

*Registered trademark

THE INTERNATIONAL NICKEL COMPANY, INC.

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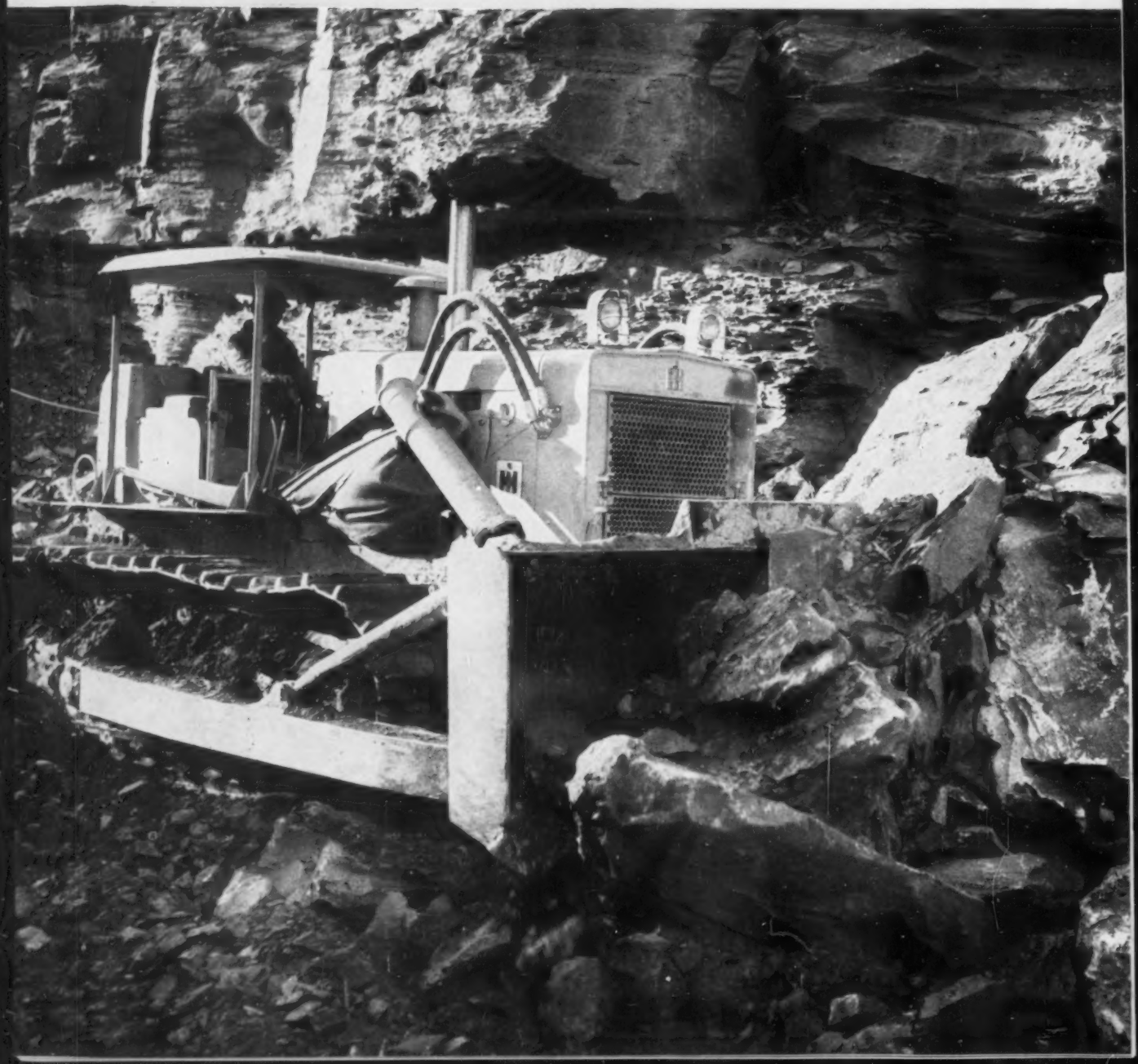
NI-HARD®

NICKEL MAKES CASTINGS PERFORM BETTER LONGER

TD-25 outproduces '24' New Power advantages high-walling—*for Morris Enterprises,*



by 20%... speed

Owensboro, Ky.

"The new International TD-25 is giving us about 20% more production than our TD-24," states Paul H. Morris, owner of Morris Enterprises, Owensboro, Kentucky. "The '25's' DT-817 turbocharged Diesel is snappy, doesn't lug down, and has the power to carry full loads without hesitation.

"I particularly like my '25's' Planet Power steering and Hi-Lo power-shifting advantages for high-wall cutting—and the good balance, which enables backing up steep grades and starting the push immediately.

"My TD-24 has clocked better than 10,000 production hours in four years, with outstanding service and very low downtime."

Full-cut benching—full time

Apply full power to the job—maintain full speed—keep the blade loaded full time—benching or high-walling with the International TD-25. You simply operate the bankside track in high speed range, the other in low speed range—for full-capacity straight ahead performance, without "fish-tailing" or "bank-nosing."

You make full-load, full-power turns with TD-25 "live-track" Planet Power steering. And with combined Hi-Lo power shifting, you get instant up-or-down matching of power to condition. You eliminate "dead-track drag" and "gear-shift" lag—and benefit accordingly.

See how the 230-hp TD-25 outproduces king-sized clutch-steered rigs by up to 50%, or more—clearing land, removing overburden, highwalling, and benching. Compare DT-817 turbocharged Diesel wallop—measure how dual-valving insures "free breathing" for clean combustion and big work capacity at all altitudes. Let your International Construction Equipment Distributor demonstrate.

"Slugging" straight ahead with an offset load of shot rock, this TD-25, belonging to Morris Enterprises, demonstrates the capacity-adding Planet Power steering principle. Operator keeps bank-side track in high range, leaves other in low range, to stay on course, with full power "harnessed." This producer removes about half of a 35' overburden with crawlers—takes off the balance with dragline.

International® Construction Equipment

International Harvester Co.,
180 North Michigan Ave., Chicago 1, Illinois

A COMPLETE POWER PACKAGE

Better than ever from

TOP

TO

BOTTOM

Top to bottom improvements in the Timken® threaded carbide insert bit assure you more hole-per-bit—lower cost per foot-of-hole. A new brazing process bonds the tough carbide inserts firmly to the bit body to resist shocks better. Inserts can be reconditioned many times. And throughout, Timken bit bodies are stronger—improvements in our heat treating process produce greater uniformity in hardness and structure. The resulting greater strength practically eliminates ring-off and breakage.

More reasons why you get more hole-per-bit: the 5 front hole design, pioneered by the Timken Company, shoots air or water straight against the rock face; then, the deeper, wider wing clearance lets chips wash back faster. Drilling goes faster. And with Timken bits you get on-the-job service from Timken Company field engineers, the kind you can't get anywhere else. It's another reason why more miners drill with Timken bits than with any other removable bit.

There's a complete range of sizes and types of Timken threaded bits for your drifters, sinkers and stopers. Send for full information in free brochure, "Timken Removable Rock Bits". The Timken Roller Bearing Company, Rock Bit Division, Canton 6, Ohio. Cable address: "TIMROSCO".

FOR OTHER TOUGH DRILLING JOBS

ALL-STEEL MULTI-USE

This improved Timken bit gives you lowest cost per foot-of-hole when you can drill out full increments of steel.

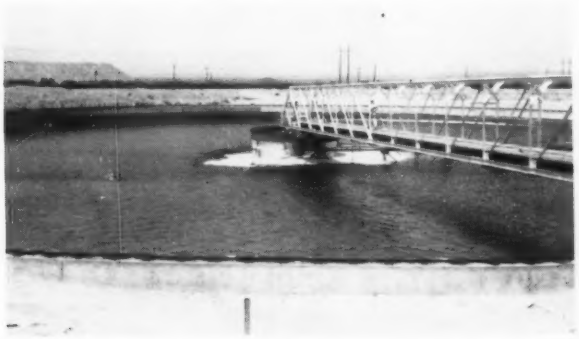
TAPERED SOCKET BIT

Secure union gives the strength of one-piece steels. Same improvements and features as the threaded bit.

TIMKEN®

removable rock bits

WHAT'S GOING ON in mining



Asarco Uses Chemical to Cut Water Loss at Mission Thickener

American Smelting and Refining Company recently sealed the bottom of two 275-foot diameter tailing thickeners at its new Mission mine to cut water loss by percolation into the compacted soil bottom.

Mission is Asarco's new copper mine and flotation mill south of Tucson, Arizona where water is both scarce and expensive. The thickeners were treated with SS-13, a chemical which retards the flow of water through soil by decreasing void space between particles by increasing the ionic attraction of such particles to water. This enlarges the hydroscopic envelope of water around each particle to form a nearly impervious layer. When the first thickener was filled with 20 inches of water, an estimated 3,500,000 gallons, it was calculated that 1,285 gallons per minute percolated into the compacted soil bottom. This was approximately 3.5 cubic feet of water per square foot of wetted area per 24 hours.

A laboratory test by the SS-13 Sales Company of Phoenix, Arizona indicated that conditions were favorable for chemical treatment—sandy type soil in contact with water containing only moderate amounts of calcium and magnesium salts. A small "on the job" drum test made right in the bottom of the thickener confirmed laboratory tests and the decision was made to treat the new thickener before any tailing was placed in it.

The first thickener was treated with 3,500 gallons of SS-13. The picture at left shows the chemical just entering the thickener. The picture at right was taken 45 minutes later and shows how the chemical distributes itself to cover entire area.

Water loss was cut to 100 gallons per minute 96 hours after treatment. This is about 0.3 cubic feet of water per minute per square foot of wetted area.

Cost of this treatment according to Harold R. Boone, Sales Company president, Box 4425, Phoenix, Arizona, was approximately $0.45 per square of wetted area installed. The chemical is available in any amount from 50 gallon drums to tank truck loads.

Shipments to Japan Characterize British Columbia Mining Boom

After contacting most of the mining companies working in British Columbia, Canada and with the help and cooperation of provincial and government officers, MINING WORLD has just completed a special survey of the unique mining boom that is now gripping western Canada. The results show that all production records are being broken, and record numbers of claims are being staked by over 60 mining companies active in the region. For example, the value of mineral production and estimated number of claims staked for the recent four years are:

Year	*Value*	*Claims*
1958	$146,000,000	13,459
1959	149,000,000	13,445
1960	179,000,000	11,748
1961	200,000,000 est.	9,000 (six months)

All of this is due to two factors: (1) the insatiable demand of the growing Japanese economy for more raw materials, and (2) recent mining legislation passed by the provincial government that has encouraged prospecting and expedited the development of known ore deposits.

Four years ago ore from only three British Columbian mines was sent to Japan. This was iron from the Argonaut Mining Company and Hualpai Enterprises, and copper concentrates from the Cowichan Copper Company. Today, iron concentrates are sent to Japan from Empire Development Company, Nimpkish Iron Mines, Ltd., and Texada Mines, Ltd.; nickel concentrates from Giant Nickel Mines, Ltd.; copper concentrates from Craigmont Mines, Ltd.; and asbestos from Cassiar Asbestos Company. Within the next few months five more properties will be ready for production with all concentrates going to Japan. These will be copper concentrates from the Sunro mine of Cowichan Copper Company, Bethlehem Copper Company, Ltd's. operations and the Benson Lake mine of Consolidated Mining and Smelting Company of Canada, Ltd.; and iron concentrates from International Iron Company's Zeballos property, Noranda Mines, Ltd's. Kennedy Lake property, and Jedway Iron Mines' Queen Charlotte Island deposits.

Some of these mines have mineral export contracts that extend over seven years, and several are going into production solely on the basis of the Japanese contracts. It is estimated that signed contracts now cover over $200,000,000 worth of minerals.

Recently, the able and aggressive minister of mines of British Columbia, The Honorable W. K. Kiernan, returned from an extensive trip through Japan, and reported that Japanese imports of British Columbian concentrates may triple within the next three years. Also, since energy costs are substantially less, the Japanese are actively studying the possibilities of building processing plants to produce blister copper and sponge iron in western Canada. This is all welcome news to British Columbia which will reap immediate and long range benefits.

Anyway you look at it, this mineral market by Japan spells BOOM in capital letters!

Cyprus and Utah Construction Will Mine Australian Iron Ore

Cyprus Mines Corporation, and Utah Construction and Mining Company have been successful bidders for iron mining rights in Western Australia. The two companies control Marcona Mining Company which is Peru's largest iron ore producer and are partners in Pima Mining Company operating the Pima copper mine in Arizona. Cyprus is a world-wide mining firm with major copper mining operations on the Island of Cyprus. Consolidated Goldfields Ltd. joint ventured the proposal which was accepted by the state government for the Ellarine Hills deposit.

The mining world awaits with interest results of September bids to mine the Mount Goldsworthy deposits believed to be one of the largest unmined reserves in Australia. More than 30,000,000 tons of ore has been developed. Bids include royalties, mining methods and rates, as well as plans for marketing (mostly to Japanese steel mills.)

Asarco's New Mission Copper Mine In Production

First copper concentrate has been shipped from the Mission project American Smelting and Refining Company south of Tucson, Arizona. Mission is the newest and largest mine in the Twin Buttes district which has been the scene of such great activity in the past several years. This cut made from an aerial photograph by W. F. Haddon is oriented about S. 15° W. and shows the open-pit mine and mill. At top right are stripping dumps from the nearby Pima Mining Company. The Mission pit is at right. Ore is trucked from pit to primary crusher dump at top. The 250,000 ton ore stockpile shows, near center, behind the two water tanks. At left is the coarse ore stock pile and secondary crusher building. The grinding and flotation section for the 15,000-ton-per-day mill can be seen clearly. The white thickener at left has been treated with SS-13 sealant. See details in this issue. The north waste dump on the Papagao Indian Reservation shows plainly at the bottom. Engineering and construction of the mill was by Western Knapp Engineering Company of San Francisco, California.

Alaska

Twin Creek Mines, of Anchorage in association with a large group of individuals plans to export placer gold by-products to Japan according to A. T. Van Dolah. A large connected bucket line gold dredge is to be floated up the Yentna River to the Fairview mining district. Equipment and supplies have been air freighted to the company's new landing strip since the first of the year. Mining is to start on a large group of placer claims controlled by a group of Alaskan business men, mine operators, and geologists.

Arizona

Pima Expansion Program to Extend Operations to 1975

Pima Mining Company has undertaken a $4,000,000 expansion program at its Pima open-pit copper mine, near Tucson, Arizona, which is expected to keep it in operation until 1975.

A new pit will be developed to mine reserves of 20,000,000 tons of 0.65 percent copper that have been established in an area and northeast of the present pit. Approximately 200 feet of overburden must be removed to reach the ore body. Reserves contained in the present pit area are approximately 8,000,000 tons averaging 1.5 percent copper, including 1,800,000 tons of Banner Mining Company ore to be produced by Pima under a custom mining and milling agreement. It is very probable that the two pits will be joined during mining. Development of the second ore body will start next year, to be completed by early 1964.

The company also plans to double capacity of its concentrate mill of 7,000 tons of ore daily.

Pima Mining is owned jointly by Cyprus Mines Corporation, Utah Construction & Mining Company, and Union Oil Company of California. Henry Mudd is president.

On behalf of private investors, **Hunting Geophysical Services, Inc.** has negotiated an exclusive mineral exploration contract on all but a small portion of the Papago Indian Reservation in southern Arizona. The permit covers all minerals exclusive of oil and gas, and has been approved by the United States Commissioner of Indian Affairs. Hunting is charged with the responsibility for designing and carrying out the exploration program, and will pay the Papagos a $20,000 cash bonus, plus rentals and royalties on any possible leases. They may take up to 25 leases of not less than 10 acres each nor more than 2,560 acres each.

The **Intermountain Exploration Company,** Richard Wyman, president, St. George, Utah, is test drilling at the **Squaw Peak** copper-molybdenum property near Camp Verde. The first diamond drill hole was drilled from the main or upper adit at a distance of about 500 feet from the portal. G. S. Thatcher is the drill contractor.

Scheduled for completion this month is the 60-ton selective flotation mill with a molybdenum circuit being constructed by the **D. M. B. D. Mining Company, Inc.,** near Mammoth, Arizona. The plant

will handle the copper and molybdenum ores from the **Childs-Aldwinkle** mine. Considerable equipment from the old mill at the **Burney** mines in Canon del Oro was salvaged and rebuilt for use at the new site. Water for milling operations is to be purchased from the City of Mammoth, and copper concentrates will be shipped to the **Asarco** smelter at Hayden. The D. M. B. D. Mining Company operates the Childs-Aldwinkle mine under lease. Currently, an ore body above the o'd main adit is being stoped, and the operators estimate that the shrinkage stope contains from 1,500 to 2,000 tons of broken ore. Principals in the company are R. A. (Bob) Burney, Oracle, president; John Dockey, vice-president; Barry DeRose, secretary; Lee Miller, treasurer. Frank Ellsworth is mine foreman.

Bill White of Yarnell, Arizona, and associates are doing some test drilling at the **Red Cloud** group of claims. This property is close to the **Old Dick** and **Copper Queen** mines near Bagdad. **Boyles Brothers** holds the contract and the initial hole has reached a depth of 120 feet.

California

Kaiser and Standard Slag Sell Iron Concentrates to Japan

Contracts totaling nearly $140,000,000 for sale of iron concentrates from California and Nevada mines have been signed recently. Kaiser Steel Corporation will ship 1,000,000 annual long tons of iron concentrate from its Eagle Mountain mine and beneficiation plant for a 10-year period. Purchaser is Mitsubishi Shoji Kaisha Ltd. which will allocate the concentrate to several steel mills. Shipments will not start until late 1962 when Mitsubishi will have completed new 50,000-long-ton ore carriers for transportation from Long Beach, California to Japan. Eagle Mountain is the largest iron mine in the west and had a peak production of 3,454,000 tons in 1959. All this was used at Kaiser's Fontana steel mill. The recently expanded crushing plant, beneficiation plant, and blending system will permit increased shipments. Specifications are reported to be a 61 percent natural iron base at $8.65 per ton with penalties and/or premiums for iron and sulphur content.

Standard Slag Company is now building a new 2,000-ton-per-day dry magnetic separation plant near its Minnesota iron mine north of Yerington, Nevada. About 1,250 tons of 60 percent plus iron concentrate will be shipped to Japan starting early in 1962 to fill a 4,000,000-ton contract. This concentrate is scheduled to be shipped over a 10-year period from Stockton, California. Standard has shipped high grade ore from this mine as well as its Iron Mountain mine at Gabbs to Japan for several years.

The underground mining operation of **Union Carbide Nuclear Company's Pine Creek** tungsten-molybdenum mine at Bishop recently completed a record 418 days without a disabling injury. Approximately 150 men worked 325,000 hours during this period which is still continuing, and is the longest period without a disabling injury in the history of Union Carbide's California operations.

Department of Interior's **Bureau of Land Management** in Los Angeles recently announced the first move by the federal government to establish deep sea mining operations off the southern California coast. The mining industry has been asked to recommend areas for leasing about 40 miles offshore, approximately midway between San Diego and San Clemente Island, where the ocean floor is covered with phosphorous-rich pebbles and boulders lying some 600 feet below the surface. Reportedly, **Collier Carbon & Chemical Corporation,** subsidiary of **Union Oil Company,** has expressed interest in the development of the submerged pebble phosphate deposit. If the Federal move results in leasing, it would be the first undersea phosphate mining venture on Federal lands, and the first such operation on the outer continental shelf of the Pacific coast.

The major construction program of **American Potash & Chemical Corporation** at Trona is progressing satisfactorily with the tune-up of the new and larger evaporation plant taking place in July. This new plant will increase the company's capacity for boron products, potash, and salt cake.

COMPANIES IN THE MINING WORLD NEWS

Central

St. Joe to Double Viburnum Mill and Sink Third Shaft

The St. Joseph Lead Company will sink a third shaft, No. 29, in Washington County, Missouri, to furnish additional ore for the Viburnum mill.

New equipment will also be installed at the mill, to double present capacity to 6,000 tons per day.

Contract for the surface construction at No. 29 has been started by Plez Lewis & Son of St. Clair. Actual sinking of the shaft will not begin until next spring, with production scheduled for 1964.

St. Joseph's No. 27 shaft, located in Crawford County, is now in production and regular production from No. 28 is expected to begin in October. These developments will bring the New Lead Belt to maximum initial capacity.

No. 27 mine was the "Underground Mine of 1960" and was so honored by MINING WORLD. The new mine was described in the July issue of MINING WORLD and the mill in August. Elmer Jones is division manager and Larry Casteel, assistant.

The **West Myer** barite mine near Del Rio, Tennessee, has been purchased by a group from Knoxville. The new owners plan additional development of the high quality barite vein, and an increase in the capacity of the mill. Recent production from the mine was at the rate of one railroad car per day. Remaining proven ore is approximately 28,000 to 30,000 tons

Tri-State Zinc Company, Inc. has purchased most of the surface equipment at the former **Stanleigh Uranium Mining Corporation, Ltd.** property at Elliot Lake, Canada. The equipment is to be moved to Tri-State's new underground zinc mine being developed near New Market, Tennessee. On August 31, 1960, Stanleigh Uranium, operating a 3,300 ton per day uranium mill, merged with **Preston East Dome Mines, Ltd.**, and all operations were suspended November 30, 1960.

Consolidated Gold Fields of South Africa, Ltd. has recently acquired on the open market a substantial interest in **American Zinc, Lead & Smelting Company.** The stock purchase was made by Consolidated Gold Fields through its wholly-owned subsidiary, **Gold Fields Mining & Industrial, Ltd.** In recognition of this transaction, Sir George S. Harvie-Watt, chairman of Consolidated Gold Fields, was recently elected a director of American Zinc.

A washing and concentrating plant, capable of handling 100 cubic yards of diamond-bearing ground a day, is now operating at the **Arkansas Diamond** mine near Murfreesboro, Arkansas. The recovery plant washes the gravel in a rotary screen with the oversize being discharged as tailing. The minus-1½-inch material gravitates to a washing pan where concentrates are periodically drawn off and sized to minus-9/16-inch. This is then jigged while the coarser material is hand-sorted and discarded. The jig concentrates are drawn off daily and hand-sorted for the final product. Arthur G. Slocum of Hot Springs is the operator.

The **Mackey-Humm** fluorspar mine and mill, plus one-half interest in the **Hicks Creek Fluorspar Mining Company,** have recently been purchased by Norbert Adick of Cincinnati, Ohio, who has formed the **N. F. A. Corporation** to operate the properties. It was announced the Mackey-Humm mill would be placed in operation as soon as a suitable source of crude ore ore could be obtained. Operations of the Mackey-Humm and Hicks Creek mines were suspended several weeks ago, pending foreclosure proceedings by **Miller-Adick Company** of Cincinnati.

Colorado

Mineral Concentrates and Chemical Company (MINCON) is now producing a wide variety of beryllium compounds at its Loveland, Colorado mill. Ore is supplied from **U. S. Beryllium Corporation's Badger Flats** mines. The mill produces beryllium oxides, acetates, sulphates, nitrates, and carbonates for use by government agencies and ceramic processors.

Standard Metals Corporation has resumed exploration work on the **Silver Lake** vein through the **Shenandoah-Dives** mine workings at Silverton, Colorado. Standard Metals did some work on the **Letter G** vein in the mine last year, but closed it early this year. The Silver Lake vein is parallel to the Shenandoah vein and is reached through a long cross cut. Drifting and raising and some stoping on the Silver Lake was done by earlier operators in the early 1940's. **American Smelting and Refining Company** owns the Silver Lake and leases it to Standard. Development of the **Sunnyside** mine in depth is continuing at Standard's **American Tunnel** near Silverton. William McCormick, Moab, Utah, is Standard president.

A new tailing delivery line is slated for completion in October on the east side of **Climax Molybdenum Company's** tailing storage area. The new line will be capable of handling increased tonnage and is being built at a higher elevation than the old line so that tailing can be stored below the line for many years. The new line is 36 inches in diameter and 2.5 miles long. It is built out of 8-foot-long sections of reinforced concrete pipe. Estimated cost of the new line is $740,000. The company's tailing engineer, Robert Steele, is making a survey for a new western line to be built in 1962.

Construction of the new uranium concentrator of the **Vanadium Corporation of America** is on schedule at Naturita, Colorado. The new mill will treat Uravan Mineral Belt uranium-vanadium ores. It replaces the old mill which VCA operated on the same site for many years. Fred Brinker, Durango, Colorado is manager of VCA's uranium operations.

The 50th anniversary of froth flotation in the United States will be celebrated in Denver, Colorado from September 17th through the 20th. The Minerals Beneficiation Division of the AIME is in charge of the program. Frank R. Milliken, president, Kennecott Copper Corporation will be the featured speaker at the banquet.

Boyles Brothers Drilling Company of Salt Lake City, Utah used a helicopter air lift to transfer diamond drills and supplies into the remote and rugged Chicago Basin district south of Silverton. Supplies were air lifted 5,000 feet and 14 miles to the drilling camp in loads of 400 pounds.

Eastern

Cornish Engine Preservation Society Requests Donations

Some 25 years ago this engine society was formed with the object of preserving a few of the fine old beam pumping engines which were then still in existence at the tin and copper mines in Cornwall, England. Generous donations from engineers in all parts of the world, who are interested in this historical aspect of engineering, have assisted the society.

The council of the society is now appealing for £ 1,500 which is the estimated cost of preserving both the engine and engine house at the South Crofty mine near Cambourne. This engine drove the Cornish pump at the Robinson shaft for more than 80 years until 1955 when the pumps were electrified. The steam cylinder is 80 inches in diameter, the piston stroke 10 feet, working pressure 50 pounds per square inch, weight of cast iron main beam 38 tons, and pumping depth 2,020 feet.

The late A. T. Holman, was president of the society and director of Holman Bros. Ltd. Preservation of the engine is

a memorial to him for his work for the society.

Checks should be made payable to: A. Treve Holman Memorial and mailed to W. M. Symons, C. E. P. S. Appeal Secretary, c/o Holman Bros. Ltd. Cambourne, Cornwall, England.

A new company, **Minerals Development Corporation,** has been formed for the possible development of iron ore deposits in southwest Virginia. A joint undertaking of the **Norfolk & Western Railway Company, Roanoke Electric Steel Corporation,** and **E. L. Keesling** of Bramwell, West Virginia, the new company expects to drill about 20 holes in iron-bearing sandstone in Giles and Bland Counties. If iron mineralization of a satisfactory grade is found, a more detailed drilling and survey program will be undertaken that will determine the exact quantity and quality of mineable ore. Stuart T. Saunders, president of the Norfolk & Western Railway, is a director of Minerals Development.

The **Shawangunk Minerals Company Inc.** plans to open the old **Wurtsboro** zinc-lead mines in the Shawangunk Mountains in southern New York. Nearly $1,000,000 will be spent on exploration, reopening underground workings, and on a new mill to be built on the foundations of a former mill. The ore bodies have been examined by geological teams from the **United States Geological Survey** and Shawangunk Mineral Company, and reportedly, studies show there is substantial ore averaging 12 percent zinc, 5 percent lead, and 0.25 percent copper. Preliminary metallurgical tests have been made in Denver, Colorado. The zinc-lead deposits in the Wurtsboro Valley were first mined in 1830, abandoned, reopened during the First World War, and again abandoned. Workings consist of a 1,180 adit, four levels, plus various stopes and crosscuts.

By the end of the year **Foote Mineral Company** expects to have additional grinding facilities installed at its Kings Mountain, North Carolina, operations to enable the company to serve a greater variety of markets for spodumene and its co-products.

Idaho

The **Idaho Universal Mining Corporation** plans open pit mining of its recently discovered deposit of rutile in Idaho County, Idaho. Claim location and initial exploration has been supervised by consulting geologist Peter N. Mulholland of Elk City. The rutile is found in a deposit of felsitic tuff. J. T. Wolford is Idaho-Universal president.

About $4,200 work of tunnel rehabilitation and other work is planned by **Clearwater Mines, Inc.,** on its claims southeast of Wallace in Idaho's Panhandle. An assessment of ½-cent per share has been levied to finance the annual work requirements. E. I. Fisher, Spokane, Washington, is secretary-treasurer.

Additional drifting and downhole drilling have been undertaken in two areas at the properties of **Bayhorse Mines, Inc.,** in central Idaho, by **Sidney Mining Company.** Work so far in the old Bayhorse mining district has resulted in dis-

covery of encouraging lenses of silver ore. Sidney, headed by Malcom Brown, Kellogg, has levied assessment No. 3 of 1.0 cent per share to finance the new work.

Annual assessment work on the **Tom Boy** and **Madonna** claims in Deadman Gulch, east of Mullan, Shoshone County, was started recently by Carl Baldwin and his son, Carl Baldwin Jr., Stevensville, Montana. They have held the claims 15 years.

Core drilling to determine the sulphur content of gypsum deposits in Washington County has been undertaken by **Russett Mining and Manufacturing Company** of Weiser. Ray Diard, Spokane, Washington has the contract and Frank Wilson, Spokane, is supervising the drilling. Diard also will process the gypsun if it proves of commercial grade. Initial work indicates a deposit more than 50 feet thick under about 12 feet of overburden.

Palisade Mining and Milling Company, Coeur d'Alene, has levied an assessment of 1.0 cent a share to finance work at its Idaho property. George M. Servick is secretary.

During 1960 the **Idaho-Almaden** mercury mining and furnacing operations of **Rare Metals Corporation of America** produced 1,538 flasks of mercury, each containing 76 pounds, with a gross sales value of $310,061. Total wet tons mined during the year were 55,841, of which 55,800 were processed with average grade of ore milled being 2.89 pounds of mercury per ton, about the same as in 1959. The company continued its exploration for mineral deposits in Idaho as well as in other western states, and also conducted extensive projects under option agreements involving thorium properties in Idaho and zinc properties in Washington.

A $365,000 Nordberg hoist capable of hoisting from a depth of 5,000 feet is being installed at the **Lucky Friday** mine east of Mullan, Shoshone County. It is scheduled to go into operation about September 1, when mill output is to be increased to about 700 tons daily from the first quarter average of 643 tons. First quarter ore production was 41,824 tons averaging 21 ounces of silver, 12 percent lead, and 1 percent zinc to the ton. L. J. Randall, Wallace, is president of **Lucky Friday Silver-Lead Mines Company.**

Silica mining on Mason Butte, seven miles west of Craigmont, Lewis County, has been started by **Lydon's Inc.**, of Lewiston. Lyndon Mack, Lewiston, is general manager.

Extensive operations are planned this spring at the **Mountain Lion** group of four lode mining claims one mile west of Murray, Shoshone County, Idaho. **Three Queens Mining Corporation** has been incorporated as an Idaho firm to work the claims. Capitalization is $50,000, divided into 50,000 shares of $1 par value stock. Incorporators were Frank Schamel of Murray; Eugene F. McCann of Wallace, Idaho, and L. J. Gugler of Spokane, Washington. Schamel has spent the last two seasons carrying on a hydraulic top soil removing project at the site of a promising surface discovery. Diamond drilling is planned along with other exploratory work this season.

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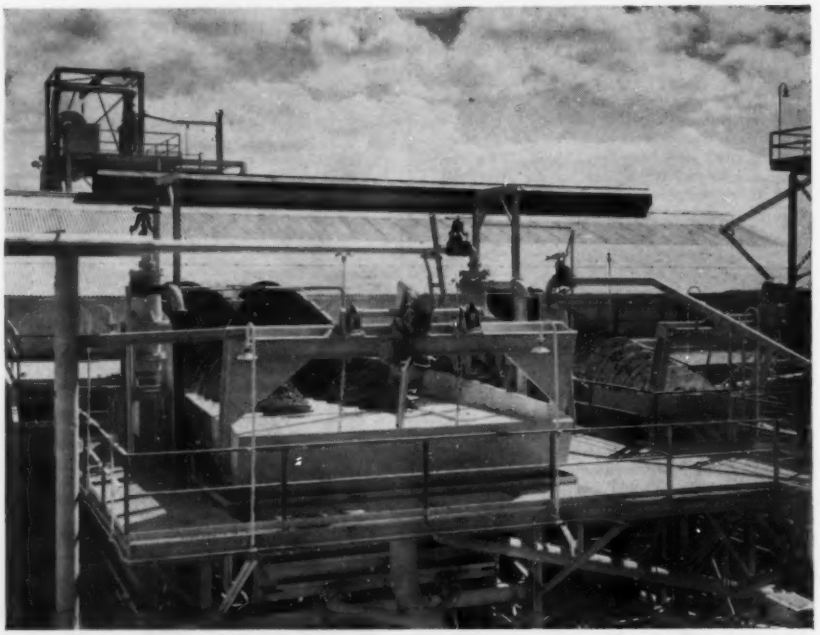

The 78" Akins Simplex Classifier, built in 1934, is dewatering coarse feed in a special flotation circuit. The new 72" Akins Duplex Classifier, with flared tank and serrated shoes, is dewatering and desliming flotation feed. Photo shows three of more than 200 Massco-Grigsby Pinch Valves purchased by Virginia-Carolina Chemical Corporation.

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Iron Ranges

Cumulative shipments of iron ore from upper lake ports for the first seven months of 1961 totaled 22,759,921 tons, as compared to 40,116,990 tons for the same period in 1960—a decrease of 43 percent. Shipments from Canadian ports for the first seven months of 1961 totaled 1,399,073 tons, compared to 2,128,969 tons for the same period in 1960.

Work has started to increase flotation mill capacity by 50 tons per hour at the **Humboldt** specular hematite mill of **Cleveland-Cliffs Iron Company** near Ishpeming, Michigan. **Western-Knapp Engineering Company** of Hibbing, Minnesota has the expansion contract. A new ball mill and related equipment will be installed for operation before the end of 1961. With the expansion, the Humboldt mill will be able to treat 5,000 tons per day of crude ore to produce approximately 2,250 tons per day of high grade iron ore concentrate as feed to the pelletizing plant.

Figures recently released show that during 1960 a total of 67,571,927 gross tons of beneficiated iron ore were shipped from mines in the United States and Canada. The largest portion, 51,612,214 tons, originated in the Lake Superior region while 7,976,602 tons were supplied by the other three United States regions; 7,983,111 tons came from Canada. Various processes used to beneficiate the ore included washing, jigging, heavy-media separation, magnetic separation, flotation, sizing, and agglomeration by pelletizing, and sintering.

The **Erie Mining Company's** Hoyt Lakes, Minnesota, taconite operations on the Mesabi Range resumed operations on July 24, 1961 after being closed down two weeks for maintenance repairs. The Erie plant is now back to its annual production capacity of 7,500,000 tons of pellets per year and employs a total of 2,500 people.

New washing equipment has been built into the **Pioneer** shaft headframe of the Pioneer iron mine in Ely, Minnesota. The Pioneer first shipped ore in 1889, but now as the mine depth is approaching 1,900 feet, a change in ore has occurred. The ore from the upper levels of the mine gradually changed from Bessemer grade to non-Bessemer grade as the deeper levels were opened. In 1937 a vibrating screen was installed in the headframe to replace a stationary Grizzley and now a complete washing unit is required. The new equipment in addition to the crusher already in place, consists of two vibrating screens, a classifier, and spirals. The walls of the headframe housing the washing facilities are insulated with fiber glass for year-around operation of the washing plant. A heating unit is in place for winter. Lump ore will be recovered ahead of the washing equipment.

Pilot plant tests for the initial unit of **Empire Iron Mining Company** are being undertaken, and plant construction should start in the spring of 1962. When completed, the first unit is expected to have an annual capacity of 1,200,000 tons of pellets, and further expansions in plant capacity will be made as required. The new mill to be built just outside Ishpeming, Michigan will recover very fine grained magnetite.

Montana

Seek Germanium Recovery From Tungsten Ores

Sylvania Electric Products, Inc. is interested in recovering about ¼ of a pound of germanium per ton in the tungsten tailing produced by Salt Lake Tungsten Company at its Dillon, Montana flotation mill. Sylvania is also investigating the possibility of recovering germanium and indium from tungsten ores of Stardust Mines, Inc. at Gold Hill, Tooele County, Utah. Gold Hill ore contains as much as 1.0 pound of germanium per ton.

Sylvania and American Metal Climax, Inc. both recover germanium in eastern plants. American Metals' ore source is a germanium-rich concentrate from Tsumeb Mines, Ltd. in South West Africa. The Eagle-Picher Company, one of the largest producers, recovers germanium from Tri-State lead-zinc concentrates.

Considerable tonnage of lead has been blocked out at the **Nellie Grant** mine west of Clancy, Montana. The mine has been shut down while a study is being made to determine how to process ore.

The **Anaconda Company** will sink a new circular air shaft between the **Steward** and **Mountain Con** mines at Butte, Montana. It is planned to be 1,700 feet deep and either 12 or 15 feet in diameter. The sinking will be contracted with the award possibly made to **Boland Development (Western) Ltd.**

One Mile Deep Under "Richest Hill on Earth"

Montana mining history was made on July 12 when The Anaconda Company's Mountain Con mine in Butte reached a depth of one mile. The vertical shaft of the mine extends from 6,081 feet above sea level, at the surface, to 801 feet above sea level at the bottom. The picture made at the mile deep level shows, left to right: Morton LaTourrette, Mountain Con foreman; Calvin Gustafson, Larry Lammi, Morris Hanninen members of the shaft-sinking crew; John Suttie, Mountain Con superintendent, and John Hoffman, New York, New York, manager of Anaconda Company mining operations. The mile mark was reached 97 years after prospectors first discovered gold in the Butte district. The shaft-sinking is part of Anaconda's plan to prepare for mining of copper ore from deeper levels in Butte.

Nevada

Officials of the **White Caps Gold Mining Company** have announced a rich ore discovery in the company mine at Manhattan. The discovery was made by diamond drilling in the virgin hanging wall of the mine, and 168 feet of core reportedly averaged 1.67 ounces of gold per ton, or $58.45 per ton. The ore body is immediately above the West ore body which, according to old company records, averaged 2.73 ounces of gold per ton over a 34-foot crosscut.

Millable ore and other materials on the **Silver Chief** claims west of Battle Mountain, Nevada, have been sold by H. R. Rieck and Blaine V. Hoalst to Ernest T. Carlow of Battle Mountain, and Ezra Edwards of Tenabo, Nevada. They have started hauling the ore to a mill near Tenabo for treatment. The material consists of silver and lead material from mine dumps. A second sale of millable ore and dump material on the **R and D** group of eight mining claims, nine miles west of Battle Mountain, was made by Mr. Rieck and George W. Dillon, Battle Mountain. Buyers were Lawrence Larmon, Hannibal, Wisconsin, and Earl C. Heffner, Boise, Idaho. They propose a run of the ore in a 25-ton pilot plant. The ore involved contains unreported amounts of tellurium, gold, silver, copper and lead.

The ferrotungsten plant currently being operated by **Kennametal, Inc.** at the **Nevada** scheelite mine in Mineral County, Nevada, uses concentrates purchased from other companies that had these stockpiled when the tungsten purchase program ended. The mine, which was closed down in 1957, was one of Nevada's leading tungsten producers before the government price support program was withdrawn.

New Mexico

Phillips Petroleum Company, is now drilling a 64-inch diameter ventilation shaft at its **Ambrosia Lake** uranium mines. **Kuehn & Rhodes Drilling Company** of Abilene, Texas, is drilling the shaft under contract. **Kermac Nuclear Fuels Corporation** pioneered shaft drilling in the district, and full details of its 90-inch diameter shaft were reported in the March 1961 issue of MINING WORLD, pages 34 to 37.

Stockholders of **Sabre-Pinon Corporation** recently approved management proposals to buy a substantial share of uranium producer, **Homestake-New Mexico Partners.** If the purchases go through, parts of the interest would be resold to **Homestake Mining Company** for $3,000,000 cash, and would result in the liquidation of **United Western Minerals Company.** The final result would be ownership of two adjacent uranium ventures by Homestake Mining and Sabre-Pinon.

The **Spencer** uranium mine in the southwest area of Ambrosia Lake, New Mexico is now being operated by **Lee Roy Cosper** and **A. W. Hyde.** First ore was mined in April from this mine which is one of the newest producers in the district. The mine is shallow so that ore is dry to facilitate mining.

A new Goodman three-forked twin-head rotary-boring continuous potash miner is now being used at **International Minerals and Chemical Corporation's** Carlsbad potash mine.

Phillips Petroleum Company has leased its **Isabella** uranium mine in the Ambrosia Lake district of New Mexico to **Kirchmann-Spencer Partnership, Inc.** The 700-foot deep Isabella mine is on the southern edge of the district and has the advantage of being a dry mine. The Partnership also operates the **Faith** mine on a Phillips lease. Robert C. Kirchmann and Jack Spencer of Grants are the partners.

Oregon

Depletion of the diatomite ore body suitable for making filter aids has caused the **Great Lakes Carbon Corporation** to close its open-pit mine and processing plant at Terrebonne. The mine had operated since 1936. Great Lakes is now supplying filter aids, insulation, fillers, etc. from its Lompoc, California mine.

Hanna Nickel Smelting Company is now selling ferronickel with a 45 percent nickel content to major steel companies. Previously all ferronickel went into the government stockpile following terms of the company's contract under which Hanna went into the nickel business. Laterite ore assaying about 1.5 percent nickel is mined from the **Nickel Mountain** open pit mine and smelted at Riddle by the Ugine process. See MINING WORLD, October 1960, page 33.

Tom Myers, Ashland, has purchased and put into production the old **Braden** gold mine near Gold Hill. Two small gold mills on the property were in operation at last report. Myers is planning an open-pit mining operation.

Utah

Utah Potash Reserves Sought By Continental and San Jacinto

Continental Oil Company and its subsidiary, San Jacinto Petroleum Corporation, have contracted for exploration on approximately 38,000 acres of potash permits and leases in Utah.

Continental has entered an agreement with Sawyer Petroleum Company covering 8,000 acres on the Crescent graben structure located in Grand County, and surrounding the Defense Plant Discovery Well drilled by the government in 1942. Continental's first test well is expected to be started by the end of September, and if satisfactory, will be followed by a multi-test well program to delineate the Potash Deposit. If an ore body is confirmed, Continental plans to begin large scale commercial potash production from the area. Sawyer Petroleum and associates have reserved royalty interest based on the sales value of all products sold.

San Jacinto has secured 30,000 acres in federal potash permits and state of Utah potash leases from the Utah Potash Company in the Salt Valley, also in Grand County. Operations will be conducted by San Jacinto and if exploration and development lead to commercial production of muriate of potash, the Utah Potash Company will reportedly realize 20 percent of the profit.

Other potash interests active in the area include Texas Gulf Sulphur Company, which is establishing a $30,000,000 potash mine, and mill at Cane Creek and also controls reserves at Seven Mile anticline; and Superior Oil Company, which has cored potash beds on the Colorado River, north of Cane Creek.

Silver-lead-zinc mineralization has been found in the Back fissure on the 2,500 foot **Daly Judge** mine level by **United Park City Mines Company** at Park City, Utah. United Park has carried on a major exploration program for several years after consolidating major companies in the district. Ore makes in the fissure between a Weber quartzite hanging wall and a limestone footwall. Exploration is also being done on the Middle and Roll fissures from this level. A diamond drilling program is planned to cut the Back fissure in the Humbug limestone below the level. Walter Dezell is United Park's mine manager S. K. Droubay is vice president and general manager.

Kennecott Copper Corporation continues to extend its ore reserves at its **Burgin** shaft in the unitized East Tintic mining district. Both underground development and surface drilling have added to reserves. Considerably more than 1,250,000 tons of ore with an average metal content of 10.4 ounces of silver, 15.2 percent lead, and 12.3 percent zinc per ton have been proven adjacent to the 1,050 Burgin level south and west of the shaft. Surface drilling from points 1,800

and 4,000 feet northwest of the shaft have found mineralization in the sediments from 1,320 to 1,455 feet deep. Plans are being made for a large size production shaft.

Washington

A $180,000 tungsten concentrator on Silver Hill, four miles southeast of Spokane, has gone into steady operation following months of testing, and alterations. At last report it was producing $2,000 worth of concentrate daily. Ore produced in open-pit mining operations is trucked to a hopper and fed onto a conveyor leading to a crusher in the mill. Mining and milling operations are on a two-shift basis. Neil Robey, Spokane mining engineer, is superintendent of operations. H. Halvorson, Spokane contractor, and Carl Coon, Spokane mining man, are principal owners. **Daybreak Uranium, Inc.**, has a 10 percent interest.

Placer mining on the Columbia River one mile north of Vantage on the Kittitas-Grant county boundary has been undertaken by Gorden Hess, Anacortes, and Norman Finn, Whidbey Island.

Open-pit lead ore mining operations are being carried on at the **Lead Trust, Lead King,** and **Crystal** mines near Leadpoint, Stevens County, by **Clayloon Mining Company,** Wilcox Bros., Spokane, have a contract to truck 50,000 tons of ore two miles to the Clayloon mill. Milling operations are being stepped up from one shift to three. More than 100 tons of concentrate has been shipped to the Bunker Hill Company's smelter at Kellogg, Idaho. Byrl Goodwin, Spokane, heads Clayloon.

Kenite, Inc., has undertaken a drilling program for deposits of diatomaceous earth near Vantage in central Washington. The New York firm has a processing plant at nearby Quincy. At last report, 25 holes had been put down to a depth of 50 feet. Herbert Sams, Elk, is the drilling contractor.

Wyoming

Level development of the new trona mine of **Stauffer Chemical Company** was started the first of August from the just completed man-and-material shaft. Development will be pushed from this one shaft until the nearby production shaft is completed; probably late this month. Sinking and concrete lining had passed the two-thirds point at 600 feet early in August. Erection of the refinery on the surface is proceeding on schedule with installation of equipment while the building is being erected around the machinery. The new mine is 21 miles northwest of Green River.

The Raymond Canyon area of southwestern Wyoming, about ten miles north of the Idaho-Wyoming border, is being explored for phosphate by Kern County Land Company of San Francisco. Phosphate in this area, investigated some years ago by **Homestake Mining Company** for vanadium values, reportedly assays between 22 and 32 percent P_2O_5. Kern County Land is also active in the Green River, Wyoming, trona district and has drilled several core holes in its leased property there.

Construction of the **Atlantic City** taconite mill of the **United States Steel Corporation** is ahead of schedule. The 76.7-mile-long railroad to the mill from Winton Junction was completed ahead of schedule and trains are now bringing in equipment and supplies over the new main line of the Union Pacific Railroad to the mill at Atlantic City. More than 2,500,000 cubic yards of dirt and rock were moved to build the grade. **Pomeroy-Bechtel Taconite Iron Ore Joint Venture** is contractor for both the railroad and the mill and related facilities. The past winter was considered mild in Wyoming which contributed to the fast schedule. To be completed ahead of winter snows are the office building, warehouse, water storage dams, closing-in of the crushing plant, mill building, and pelletizing plant. First pellets are to be shipped 355 miles by railroad to **Columbia-Geneva Steel Company's Geneva Works** in late 1962.

Bentonite production in Wyoming totaled 1,096,850 tons in 1960. The leading producers were: **Archer-Daniels Midland Company,** 266,140; **American Colloid Company,** 214,147; and **National Lead Company,** 189,388 tons; all from northeastern Wyoming. Greybull district shippers were **Magnet Cove Barium Company,** 142,431 tons and **WyoBen Products Company,** 52,483 tons. **International Minerals and Chemical Company** mined 128,972 tons; **Black Hills Bentonite Company,** 72,947; and **Benton Clay Company,** 30,437.

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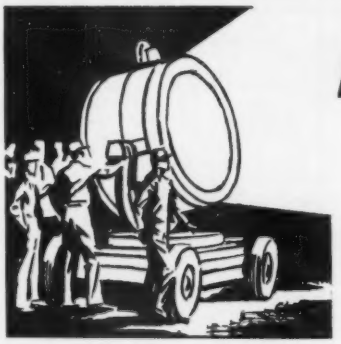

AAA LIQUIDATION SALE
RINGWOOD MINE

Ringwood, New Jersey

AIR COMPRSSORS
2—I.R. Type XRE, 1500 CFM, 300 HP with controls
4—Westinghouse Type 4-YC, 7½ HP with controls
1—CP Model D880, Portable, Diesel Engine, 315 CFM
1—Worthington Type HXE, Portable Gas Engine, 315 CFM

BALL MILL
1—Hardinge 8' x 22", 150 HP with controls, 4 Ton of 3" Balls and Parts

BELT CONVEYORS —
Will sell components as follows:
500—Trough Idlers 20", 24", 30" and 36" all 6" Dia.
200—Return Idlers 20", 24", 30" and 36" all 6" Dia.
4000'—Belting 4-5 and 6 ply 20", 24", 30" and 36"
20—Head Pulleys for above Belts 24" and 30" Dia.
20—Tail Pulleys for above Belts 20" and 24" Dia.
20—U.S. Syncro and Link Belt Drives 3, 5, 10, and 20 HP
2—"Transportometers" for 24" & 30" Belts. 80 & 120 TPH at 200 FPM
1—Rex Belt Tripper, Automatic and Reversing 24"

BELT CONVEYORS MAGNETIC
1—36" x 25' with Dings 36" x 32" Pulley
4—30" x 8' with Dings 42" x 30" Cobber Pulley
8—36" x 14' with Dings 42" x 36" Crockett Separator, Stainless Steel incased, filled with oil, type AHM

BUCKETS — GRAB & SCRAPER
1—Blaw-Knox, Size 736, Cap. 3½ Cu. Yd.
1—Blaw-Knox, Size 734, Cap. 3 Cu. Yd.
2—Amco 48" Scrapper
3—Amco 36" Scrapper
1—Amco 60" Scrapper (Unused)
1—Koehring Dipper, ¾ Yd., with arms for No. 304 Shovel (Unused)

CABLE & WIRE (UNUSED)
2—Rolls—Bethlehem 1⅛" Dia., 6 x 21, 4200' each roll.
2—Rolls—Anaconda #2/0 trolley wire 6000'
1—Roll—Bethlehem ⅞" Dia., 6 x 19, 500'
1—Roll—G.E., 3 Conductor, lead covered, 500'.

CARS — MINE
15—Granby—94 Cu. Ft., side dump (Unused)
15—Granby—75 cu. Ft., side dump.

CLASSIFIERS
3—Dorr Duplex 4' x 25', Type DSFH.

CRANES
1—Euclid 20 Ton Cap. 30' Span, 45' Lift, 3-Motor. AC Voltage, Modern.
1—Link Belt Crawler, 1½ Yd., Clam Bucket, Ser. 1837.

CRUSHERS
1—Telsmith Model 10-B, 1¼" openings, Cap. 38 to 44 TPH, 30 HP, Ser. 1504
1—Birdsboro Buchanan, Type C, Jaw, Size 30" x 42", 100 HP, Ser. 1092.
1—AJO—Taylor 60" Dia. x 18", 2—100 HP with Controls.
1—Penn. 24" x 24", Single Roll.
1—Symons, 4' Short Head Cone crusher, Coarse Bowl, 125 HP Motor.

DRILLS — DRIFTER — STOPEHAMMER — GRINDERS
2—IR, DA—35, on 9' shells.
14—IR, DA—35 on 4' shells.
6—IR, JA—55 Jack Hammers.
6—IR, JR—38 Jack Hammers.
23—IR, P-48 StopeHammers.
1—IR, Size JA—3, Air Grinder for Bits.

DUST COLLECTOR
1—AAF "Roto-Clone" No. 36, Type W, 30,000 CFM, 75 HP with Controls.

HOISTS
1—Nordberg—Double Drum, 6' Dia. x 66" Face. 1000 RPM of 16,000 lbs. line pull drum, Cap. 4—450 1⅛" cable. 500 HP 3-60-2300 Volts. All controls.
1—Belmont Double Drum. 300 HP-3-60-2300 Volts. All controls.
1—Lidgerwood, single drum, 8' Dia. x 4' Face. G.E. 150 HP.
1—Link Belt Slope Hoist. Side D-20. 48" x 48" Drum. 700' 1" Cable.

HYDRO-SEPARATORS
2—Dorr, Type A, 8' x 4' Deep. 1½ HP, S/N 7861,7860.

HOISTS & SLUSHERS — AIR
6—IR, Model EUA, 1000 lbs. cap.
1—Joy Double Drum, Model EP113-33, 50 HP.
3—Joy Double Drum, Model EP 113-38, 30 HP.
2—Joy Double Drum, Model EP 110-115, 15 HP.
1—Joy Triple Drum, 30 HP.

LABORATORY EQUIPMENT
1—Sturtevant Jaw Crusher, Size 6" x ½" opening.
1—Sturtevant Roll Crusher. Size 5" x 7".
1—Sturtevant #339 Disc Grinder, 10" dia.
1—Lot of Miscellaneous, comprising complete lab., Tables, Glassware, Scales, Furnaces, etc.

LOCOMOTIVES
2—G.E. Diesel Electrics, 60 Ton, 425 HP, Cooper-Bessemer Engine. S/N 13142 and 15091.
4—G.E. Electric Mine Type, Model IME2C4-A6, 4 ton Cap. 36 Gauge.

MACHINE SHOP EQUIPMENT
1—Toledo 2" High Speed Pipe Threader and Cutter.
1—Williams 6" Pipe Threader & Cutter.
1—Acme Bolt Threader, Model BB-2793.
1—Saunders Threader & Cutter.
1—Shumaker Lathe, 34" x 12'.
3—Wilson Arc Welders, 250 and 400 AMPS.
1—Aurora Drill Press.

MISCELLANEOUS
1—Crocker Wheeler 50 KWMG Set 75 HP.
1—G.E., 6 KWMG Set, 10 HP.
1—Eimco Mucking Machine No. 21. 36 Gauge.
1—Broughton Mixer, 54"L x 48"W x 28"D.
1—Large Lot of miscellaneous supply items. Valves, pipe, drill bits, cable, wire, sheeves, bearings, starters, etc. Approximately $50,000 replacement inventory including spare parts. (All unused).

PUMPS — CENTRIFUGAL
3—IR Model 1½ CNT6, 200 GPM, 75 Hp.
2—IR Model A, 300 GPM, 230' Head, 30 Hp.
2—IR Model A, 200 GPM, 430' Head, 40 Hp.
1—IR Model A, 200 GPM, 230' Head, 20 Hp.
1—IR Model B, 50 GPM, 130' Head, 3 Hp.
1—Deming Deep Well. 8 Stage, Figure 4700, No. 12, 100 Hp.
1—Deming, 8", 2500 GPM, 160' Head, 150 Hp.
1—Worthington, 8", 2500 GPM, 160' Head, 150 Hp.
2—Worthington, Model 5-LG-1, 8", 100 Hp.
1—Worthington, 4-Stage, 35 Hp.

PUMPS — SAND
2—Wilfley, 1", Model CA, 5 Hp.
2—Wilfley, 2", Model CA, 7½ Hp.
7—Wilfley, 3", Model CA, 20, 25, 30, & 40 Hp.
3—Wilfley, 4", Model CA, 20, 25, & 30 Hp.
1—Wilfley, 8", Model CA, 100 Hp.
1—Linatex, 3", Model M, 200 GPM, 40' Head.

RAILROAD TRACK
1500 Tons—80, 90 & 100 lb. relaying rails. Including all accessories.

SCREENS — VIBRATING
3—Tyler "Ty-Rocks" 5' x 12', Double Deck, type 600, with fines Hoppers, 10 Hp.
7—Tyler "Hummers", 4' x 5', Type 38, Single, Deck, wet or dry.
1—Tyler "Hummer" 4' x 6', Single Deck.
1—Tyler "Hummer" 3' x 5', Single Deck.
1—Tyler "Hummer", 2' x 4', Single Deck.

SIZER
1—Dorr Fahrenwald, Type EX-8, 8—Pocket, S/N US7864.

TABLES — CONCENTRATING
8—Deister Triplex—Plateau Deck—4RH, and 4LH, Intermediate. 2 Hp.
16—Deister Simplex—Plateau Deck—4RH, and 4LH Coarse, 2 Hp.

THICKENERS
2—Dorr 30' Dia. Type AX Mechanism.
1—Dorr 80' Dia. S/N 457865.

TRANSFORMERS
2—Wagner, 1500 KVA, 33,000/2300 Volts.
1—Westinghouse, 300 KVA, 2400/480 Volts.
2—Allis Chalmers, 200 KVA, 2400/480 Volts.
3—Westinghouse, 150 KVA 4800/2400, 480/240/120 Volts.
3—G.E., 50 KVA 2500/120 Volts.
3—Westinghouse, 37.5 KVA, 2200/440 Volts.
3—Westinghouse, 37.5 KVA, 2400/240/120 Volts.
22—Miscellaneous Transformers. 5-10-15-20 and 25 KVA.

VACUUM FILTER
1—Dorr Continuous 10' x 5' Face, 155 Sq. Ft. Filter area, with 40 Hp. vacuum pump, cap. 40 TPH.

WEIGHTOMETER
1—Merrick Model "E", 20" Belt. S/N 423.

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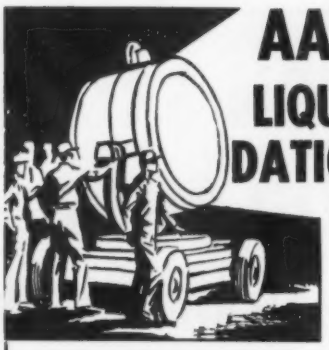

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1—65' high, chain type, 6" x 10" buckets
1—55' high, continuous, belt type, 10" x 16" buckets.

CONVEYORS — ALL TYPES

2—16" x 15' screw feeders.
1—24" x 40', steel apron, complete structural
1—48" x 13'-6", magnetic, 30" dia. pulley
1—20" x 80', trough belt, 7½ HP
1—24" x 40', trough belt, 5 HP
2—30" x 50', trough belt, 10 HP
1—30" x 168', trough belt, 100 HP
1—30" x 237', trough belt, 100 HP

CRUSHERS

1—Symons 4' short head, coarse bowl & liner, 150 HP with controls, Ser. #4953.
1—Symons 4' standard, fine bowl & liner, 100 HP & controls. Ser. #4392.
1—Double roll, 48" wide x 36" dia. rolls, 100 HP motor.

HOPPERS & STORAGE BINS

4—150 tons capacity, 2-compartment, O.D. 16' x 20' x 27' high.
1—375 tons capacity, cylindrical, cement bin.
2—100 tons Aggregate bins with batch hoppers & scales.
1—375 tons capacity, 5-compartment.
2—50 & 100 tons capacity, with batch hoppers & scales.

SCREENS

2—Tyler "Ty-Rocks" Model F-600, 4' x 14', 3 deck
1—Tyler "Ty-Rock" Model F-600, 4' x 14', 2 deck
1—Tyler "Hummer" 4' x 8', single deck, 3 vibrators

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SW 1-3900
Mr. Edward Richman

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ROTARY DRYERS & KILNS!

1—Vulcan 10' x 11' x 175' kiln, 13/16", 2-tire
2—National 10' x 78' dryers, ¾" shell
2—8'-6" x 70' rot. dryers, ⅝" welded
1—Traylor 8' x 80' dryer, ⅝" welded
2—Davenport 8' x 60' dryers, 7/16" welded
3—Stearns-Roger 8' x 40' dryers, ½"
1—7'-6" x 63' rotary kiln, ½" welded
1—Allis-Chalmers 7' x 120' kiln, ⅝" welded.
1—7' x 6' x 100' rotary kiln, ½" shell
1—Standard 7'-6" x 60' dryer, ⅜" welded
1—6' x 150' kiln, ⅝" welded
1—4'-6" x 40' kiln, ⅝" welded

MILLS — PULVERIZERS — CRUSHERS

1—Symons 2' shorthead cone crusher
1—Symons 2' standard cone crusher
1—Bonnot 5' x 10' ball mill, 75 HP.
1—Hardinge 8' x 48" conical pebble mill
2—Hardinge 7' x 36" conical pebble mills
1—Raymond 66", 6-roller hi-side mill
1—Farrel 36" x 15" jaw crusher
1—Buchanan 24" x 13" jaw crusher, 50 HP.
3—Allis-Chalmers 5' x 22' ball-tube mills
1—Allis-Chalmers 6' x 16' ball-tube mill

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Ball Mill 6 x 4½ Straub w/100 hp slipring motor
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Crusher 4 ft. Symons standard
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Crusher 10 x 20 Denver Eq. roller-bearing
Rolls 42 x 16 Allis-Ch., all new parts; two 25 hp 220/440 motors ball-bearing v-belt-drive
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Filter 6 ft. 3-leaf Eimco acid resistant
Flotation 3-Cell 44 x 44 Wemco Fag
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TRANSFORMERS —
Single Phase, 60 cycle, Moloney & GE
500 KVA, 22,000 Pri., 2300/4000Y Sec.
333 KVA, 22,000 Pri., 2300/4000Y Sec.
GENERATORS —
M-G Sets, DC Output, AC Drive
750 KW, 250/275 VDC, 4000 VAC, GE
500 KW, 250/275 VDC, 2300/3/60 VAC, West.
ROTARY CONVERTERS —
600 KW West. 1200 RPM, 250/275 DC, 2300 AC
500 KW West. 1200 RPM, 250/275 DC, 2300 AC

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1150-B Bucyrus-Erie Dragline. Excellent mechanical and electrical condition.

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1—36" Belt Conveyor, 2600' long complete with motors, controls, etc. In very good condition.

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200—4, 20 & 30 yd. dump cars
16' Gayco Air Separator W/Motor
2—5'x8' Kennedy Van Saun Air Swept Ball Tube Mills with disc feeders, fans, piping
4½'x9' KVS Air Swept Ball Mill
2 Wemco 2M—HMS Plants
5' x 5', 6' x 4' & 6' x 9' Traylor Ball Mills
No. 56 and 7'x15' Marcy Ball Mills
10' x 48" & 5' x 22" Hardinge Ball Mills
4'x11' & 7'x15' Marcy Rod Mills
636 Allis Chalmers Hydracone
20" Allis Chalmers Gyratory Crusher
12" x 26", 14" x 28", 18" x 36", 30" x 36", 48" x 60", 66" x 84" Jaw Crushers
8" x 10" Denver Jaw Crushers, rebuilt
24"x14" & 42"x16" Type B A.C. Roll Crushers
5½' Symons Std. Cone Crusher
7' Symons Snort Head Cone Crusher
78"x36'6" Akins Duplex Spiral Classifier
8'x37'x19' Dorr Bow Rake Classifier
6'x50' & 8'x60' Rotary Dryers
7' x 120' & 9' x 162' Rotary Kilns
4—30"x32" Dings Magnetic-Head Pulleys
Model BX-100 Sutton Steel & Steel Table
8, 12, 23, 25, 45, 100 & 115 ton GE & Alcoa Diesel Electric Locomotives
25 ton Ind. Brn. Hoist Dsl. Loco. Crane
690', 1100', 1500', 2230', 3078', & 7608', Inger-Rand Elec. Compressors
2—15 HP Inger-Rand 2D Slushers
500—50 ton & 70 ton Gondola Cars

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One Nordberg double drum 10' dia., 10' face, both drums clutched, 4500 ft. 1½" rope, 1200 FPM, 38,000 lbs. line pull, 1250 H.P., 2200 volt, 3 phase, 60 cycle, with all electrical and mechanical controls. Located Michigan.

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One mile from Creede, Colorado. Four U.S. patented claims, approximately 35 acres. Owner disabled. $15,000.
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WANTED POWELLITE property containing tungsten and molybdenum. Deposit should be wide enough and large enough to be mined with power shovel. Should contain more than million tons of commercial ore. Bank references. Mine Operator, Box 889, Reno, Nevada.

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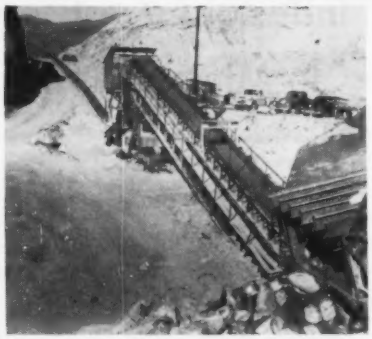

60" x 150' cc Belt Conveyor

Agitators
3—4' x 5' Wemco, wood tanks, 1½ HP
1—3' x 3' Denver, steel tank, 5 HP
2—25' x 20', steel tanks, 48" propellers, 30 HP
1—7' x 7' Galigher, less tank, 15 HP
1—5' x 5' Wemco, steel tank, 3 HP

Air Receivers
1—5' x 12', horizontal, ASME coded
1—5' x 16', Richmond, vertical, coded

Blowers
1—TM-8 Coppus, 15 HP
3—TM-7 Coppus, 10 HP
1—SM-425 Coppus Vano, 15 HP
10—Size 6, Buffalo, Type E, 20 HP
1—Size 800, American, Type E, less motor
1—Size 50 Sturtevant, 15 HP
6—2200 cfm I-R Motor Blowers, 15 HP
1—SM-500 Coppus Vano, 30 HP
1—Model 60-26.5 Joy Axivane, 30 HP

Cars
22—20 cu. ft. End Dump, 24" ga
7—186 cu. ft. Differential Steel, 24" ga
8—52 cu. ft. C.S. Card, Granby, 24" ga
14—130 cu. ft. Granby, 30" ga
14—84 cu. ft. Granby 30" ga
5—85 cu. ft. Granby, 30" ga New
18—154 cu. ft. Sanford Day, bottom dump, 42" ga

Classifiers
1—6' x 23' Dorr Duplex, 5 HP
1—60" x 26' Wemco Spiral, 5 HP
1—72" x 32' Wemco Spiral, 10 HP
1—4' x 15' Dorr Duplex, 3 HP

Compressors
1—XRB Ingersoll Rand, 100 HP
2—WN-4 Sullivan, 400 HP
1—XCB Ingersoll Rand, 200 HP
1—XRE-2 Ingersoll-Rand, 175 HP

Concentrators
8—#6 Diester Diagonal Deck, 2 HP
3—#14 Diester Diagonal Deck, 1½ HP

Conveyors
1—42" x 1250' Link-Belt, 2-100 HP. Gearmotors
1—60" x 150' Conveyco, 100 HP. Gearmotor
1—30" x 490' Jeffrey Sectional 52-H, 15 HP
1—30" x 450' Jeffrey Sectional 52-H, 15 HP
1—30" x 330' Jeffrey Sectional 52-H, 15 HP
1—60" x 30' Hewitt Robins, 40 HP
2—48" x 22', steel frame, 5 HP. Motorized Pulley

Crushers
1—Size 2033 Cedar Rapids Hammermill
1—30" x 60" Pennsylvania, single roll
2—4' Symons Standard Cone
1—10" x 30" Pacific Jaw, 40 HP
1—18" x 30" Telsmith, 60 HP
1—13-B Telsmith Gyratory, 75 HP

Feeders
1—24" x 40' Stephens-Adamson Apron, 10 HP
1—36" x 15' Link-Belt Apron, 3 HP
2—60" x 16' Pioneer-Oro Apron, 20 HP
1—4' x 10' Stephens-Adamson Plate, 15 HP
3—24" x 5'-8' Denver Belt
6—Type 4 Jeffrey Vibrating, 24" and 30" Pans
1—Type 45-A Syntron Vibrating, 30" x 60"

Filters
1—6' - 3 disc. Eimco
1—6' - 6 disc. Eimco
1—4' - 3 disc. Denver
1—4' x 5' Denver Drum
1—6' x 8' Morse Drum

Flotation
1—8 cell No. 18 sp Denver Sub-A
1—6 cell No. 21 Denver Sub-A
1—2 cell No. 24 Denver Sub-A
2—6 cell No. 5 Denver Laboratory
53—56" x 56" Fagergren, steel tanks

Generators
1—50 KW Caterpillar Diesel, 220/440 V
1—125 KW GMC Diesel, 220/440 V
1—36 KW Shepard Diesel, 440 V

Hoists, Mine Shaft
1—125 HP. Puget Sound, 1 drum, 440 V
1—100 HP. Denver Engineering, 1 drum, 440 V
1—150 HP. Vulcan, 1 drum, new
1—250 HP. Allis Chalmers, 1 drum, 2200 V
1—675 HP. Vulcan 2 drum, 2200 V
1—600 HP. Vulcan, 2 drum, 2200 V

Hoists, Slushers
3—CF-211 Sullivan, 2 drum, 50 HP
1—20 NN2C I-R drum, 20 HP
1—BF212 Sullivan, 2 drum, 20 HP
13—A5NNOH I-R, 2 drum, air
3—FF-211 Joy, 2 drum, 15 HP
1—20 ML4D I-R, 2 drum, 20 HP
1—AF-211 Sullivan, 2 drum, 10 HP
3—FF-211 Joy, 2 drum, 15 HP
3—15 NM2F I-R, 2 drum, 15 HP
1—15 NN1F I-R, 2 drum, 15 HP
3-20 NM2C I-R, 2 drum, 20 HP
7—30 NN3D I-R, 2 drum, 30 HP
1—N-311 Sullivan, 3 drum, 25 HP
1—BF-312 Sullivan, 3 drum, 20 HP
1—BFA-312 Sullivan, 3 drum, 30 HP

Hoists, Tuggers
15—HU Ingersoll-Rand, air
7—D6U Ingersoll-Rand, air
10—HB Gardner-Denver, air
1—DF-113 Joy, 7½ HP. electric
8—L-111 Joy, piston air

Hydroseparators
2—24' x 8' Process Engineers, steel tank
1—36' x 10' Process Engineers, steel tank

Jigs
11—4 cell, 42" x 42" Yuba
1—16" x 24" Denver Duplex
1—12" x 18" Denver Duplex

Locomotives
1—4 Ton Mancha, Titan A, 24" ga
1—8 Ton Goodman, 24" ga
4—1½ Ton Mancha Little Trammers, 24" ga
1—8 Ton Plymouth Diesel, 24" ga
1—7 Ton Plymouth Diesel, 18" ga
1—Tramaire, 24" ga, 36" x 72" tank

Mills
4—6½' x 12' Allis-Chalmers, rod
1—10½' x 12' Allis Chalmers, ball, 700 HP
5—8' x 9' Traylor, ball, 250 HP
1—5' x 10' Marcy, ball, 100 HP
1—10' x 48" Hardinge, ball, 400 HP

Muckers
6—12-B Eimco, 24" ga
4—No. 21 Eimco, 24" ga
1—HL-3 Sullivan, 18" ga
1—No. 21 Eimco, Incline, 42" ga
2—Model 630 Eimco

Rods, Grinding
400 Ton 4" dia. x 14' long

Samplers
1—21" Denver Automatic, new
5—21" Denver Automatic
1—16" Galigher, Automatic

Screens
3—4' x 12' Tyler Ty-Rock, F-600
2—6' x 12' Allis Chalmers, Lowhead
3—6' x 14' Hewitt-Robins, Vibrex
1—4' x 10' Tyler Hummer
1—5' x 12' Allis Chalmers Lowhead
2—4' x 8' Symons Rod Deck

Shovels and Draglines
1—255 A P and H Shovel, ¾ Yd
1—111-M Marion Shovel and Dragline
1—170-B Bucyrus-Erie, 7 yd
1—20-B Bucyrus-Erie, ¾ Yd
1—255-A P and H Dragline, 40' boom

Thickeners
1—10' x 6' Morse, Less tank
1—20' x 10' Wemco, steel tank

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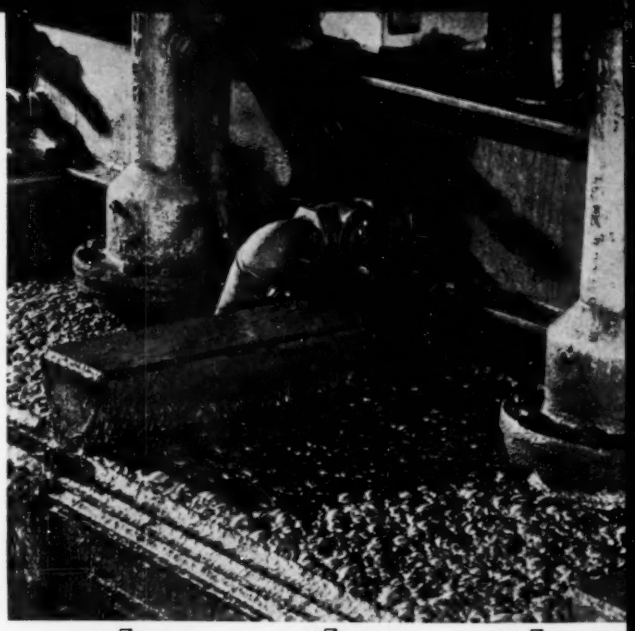

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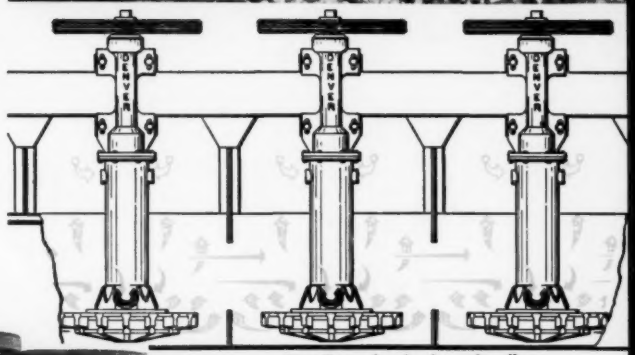

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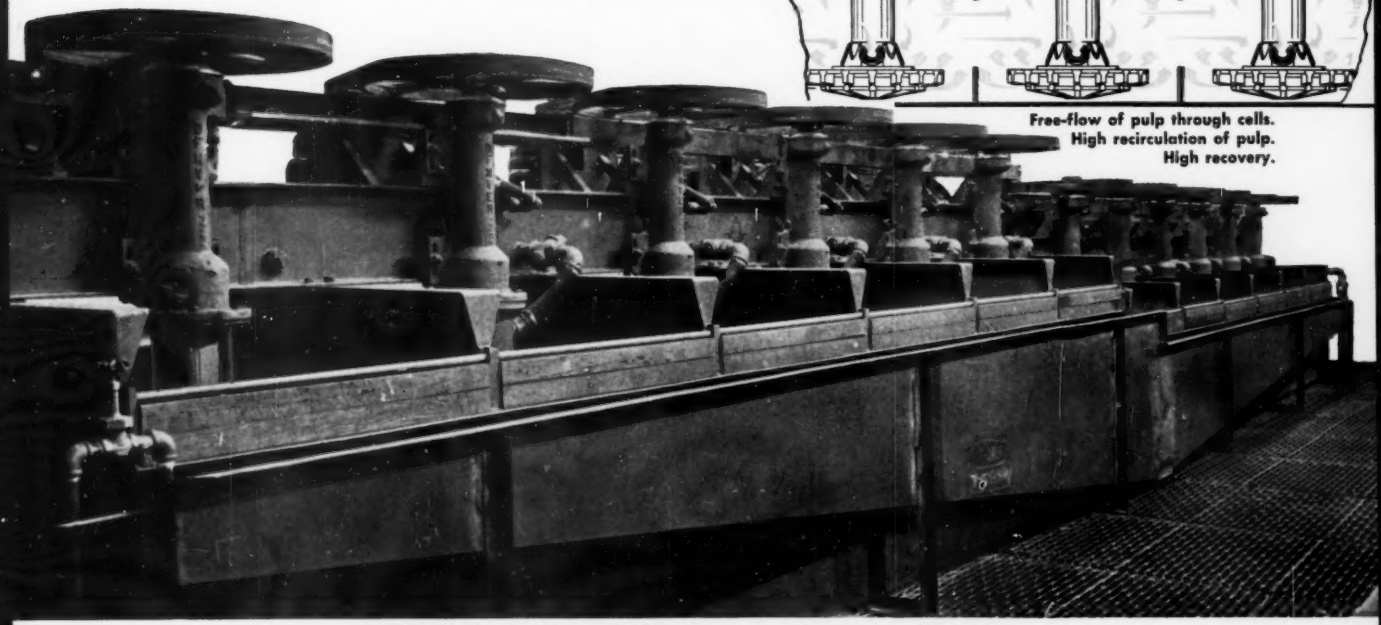

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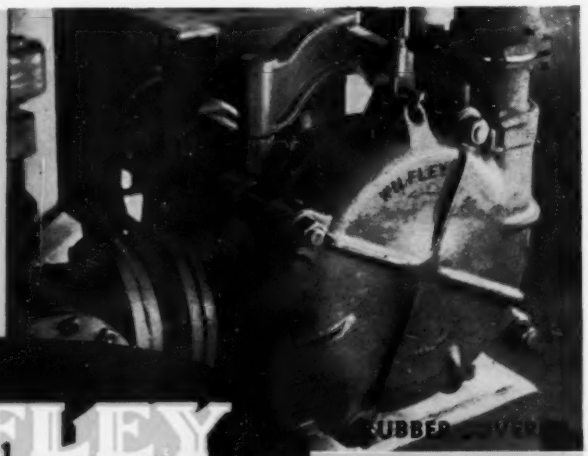

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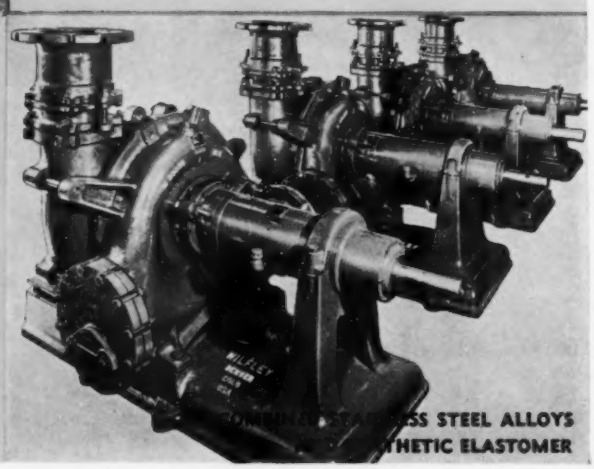

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